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Fertilizer Placement Machine for Experimental Plot Work *Gustave E. Fairbanks*

Engineering Development of an Automatic Hay Baler *George B. Hill*

Techniques for Drainage Investigations on an Irrigation Project *A. F. Pillsbury, R. C. Reeve, et al*

Some Results of Economic Studies of Farm Electrification *Joe E. Davis*

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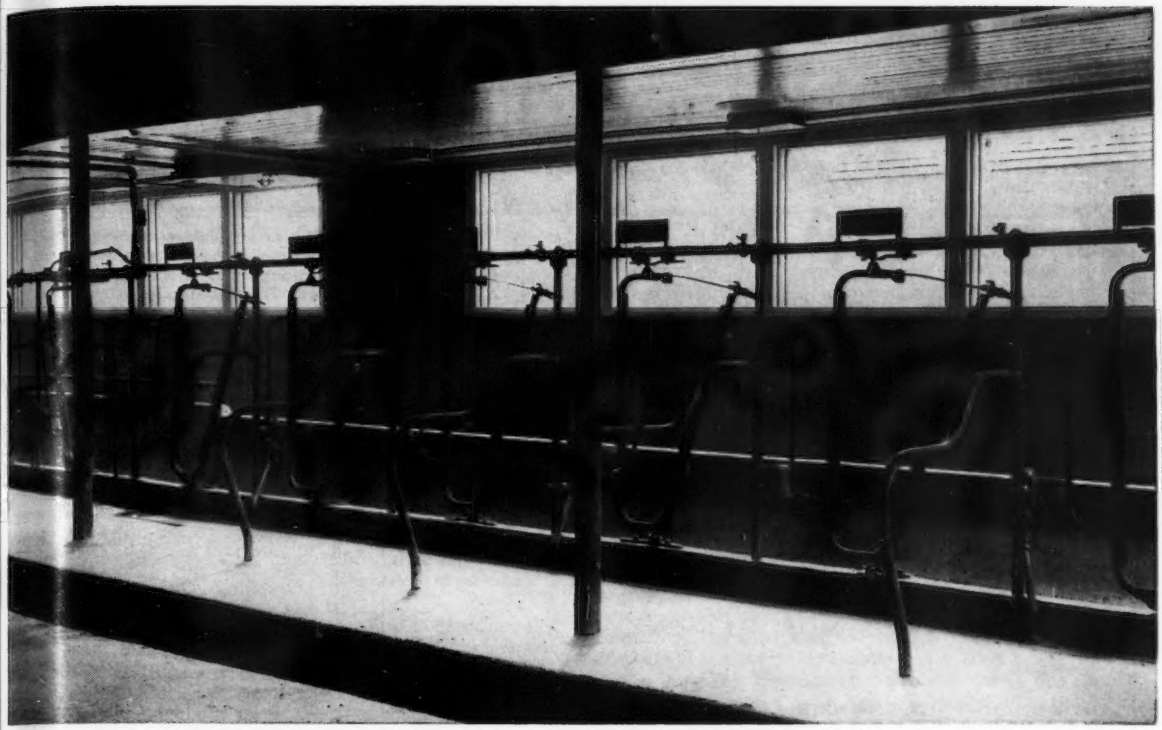

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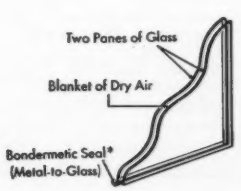

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EDITORIAL

"Freedom Isn't Free"

ON THIS subject, the North Atlantic Section of the American Society of Agricultural Engineers heard a stirring address at its meeting in August, by Rob Roy Macleod, commercial manager, western division, Niagara Mohawk Power Corp.

Mr. Macleod's address will not be published in AGRICULTURAL ENGINEERING because its subject matter covers so much more than the specialized field of agricultural engineering, to which the major content of this journal is limited by practical considerations. But it is important information for agricultural engineers and a limited number of copies are available on request to ASAE headquarters.

It is important as a warning worth considering, of a danger to the freedom under which agricultural engineers, among others, can work most effectively and with greatest satisfaction.

It is important to agricultural engineers because they are in a better position than many to help other people toward sound thinking on the subject, to combat the danger in their own as well as the public interest.

It is understandable to engineers because it deals in principles which may be applied and practiced to preserve our freedom.

It presents human activities as governed by principles in three related spheres—the metaphysical or religious, the social, and the material. It pictures the well-being of the American, not as a result of superior resources or ability, but as a result of the acceptance of a religious concept of human freedom and equality, which produced a supporting government and social system of self-government by law and principle; and as a further result of these religious and social concepts leading to the development of concepts and practices in the material or economic sphere which have been favorable to material progress.

It traces the development of the concept of freedom and the practice of principles, by which it may be preserved, through a long chain reaction: From Abraham's concept of one God of truth, justice, and right; to Moses' code of conduct and principle of equality before the law; to Jesus' teaching of the brotherhood of man; to the principles of human rights written into the Constitution of the United States to establish and guide a government of principle deriving its powers from the consent of the governed.

It calls attention to the dangers to freedom seen by some of the great statesmen and scholars of history; the human characteristics which seem to make the present population of the United States a borderline case as to capacity to enjoy and maintain their freedom. It includes in these characteristics the common human failure to appreciate a good thing until it is lost; to take it for granted and assume that it cannot be lost. The common desire to avoid responsibility. The human tendency to give more attention to the attainment and prodigal use of individual prosperity, than to the foundations on which that prosperity rests. Intolerance, carelessness, cowardice, want of public spirit, ignorance, indolence, greed, corruption, and extravagance. Failure to realize that freedom is always under attack. Failure to recognize the attacking forces of despotism, statism, dictatorship, and lust for power in various other forms and degrees, under their camouflage of expressed good intentions, promises, and appeals to false hopes. The false hope of bargaining freedom for security. Excessive concern for individual rights, to the neglect of concern for related responsibilities.

The address points to five concrete steps which we Americans can take to meet the price of our own freedom: (1) Strengthen our foundation of faith, (2) place freedom above every other aim of our political system, (3) restrain selfishness, (4) conquer indifference, and (5) halt extravagance.

These all require self-discipline to an extent which seems to be becoming less common than in the early years of our nation.

In terms of engineering, freedom is a relatively unstable condition. It tends to be self-destructive; to encourage the development within a few generations of weakness favorable to its downfall. It tends to operate as one phase of a cycle. Freedom or lack of freedom materially influence the environment of a people, their resulting acquired characteristics, and in turn, their capacity to maintain and enjoy freedom.

Freedom has been won and developed at various times and places throughout the world under conditions sufficiently adverse to favor the development of strong character, personal integrity, and ability.

It appears to have been lost again repeatedly when it produced more prosperity than the people could stand; when it relieved the people of adversity to an extent which encouraged softness and irresponsibility, rather than the stoic virtues on which freedom thrives.

These generalizations cannot safely be applied to specific individuals. History records that high character and personal integrity were far from universal among the founders and early citizens of our nation. Neither is low character, irresponsibility, and corruption the universal result of more than 150 years of our national freedom.

The important question is, which element of our population is in the majority, how strong is its majority, and which element is gaining in strength in relation to the other.

The idea and ideal of freedom is not in danger. It can lie dormant for an indefinite period and rise to flower again when conditions are favorable.

The continuing practice of freedom and realization of its advantages here, now, and in the immediate future appears to be in great danger!

Will the controlling majority see and pay the price of their freedom or risk the much higher price of losing it? Can they learn to fully appreciate freedom without living through a Valley Forge, a Chateau-Thierry, a Pearl Harbor, or a Korean campaign?

Can enough people see and resist the debilitating temptations of freedom to maintain the strength to keep it alive?

The price of freedom has been called "eternal vigilance". It might be said further that this vigilance must be applied to the exercise of character-building mental and moral self-discipline rigorous enough to supplant the character-building rigors of nature and human tyranny from which we have been relieved.

Can any such self-discipline be made popular enough to assure a continuing strong free people?

Can the people who see the need of paying the price of freedom segregate themselves or otherwise maintain and increase their strength enough to insure the continuing existence of at least one strong example of the means and desirability of freedom?

Can the capacities of individuals to exercise the responsibilities of freedom be measured, and can various grades of citizenship be established with responsibilities graduated according to ability and integrity? For example, could some easily established criterion of judgment, more accurate than age, be made the governing factor in determining the right to vote?

Can the rights and privileges of our citizens who accept their related responsibilities be better protected from the actions of other citizens who show themselves to be unfit or unwilling to accept their responsibilities as free people?

Someone, possibly an engineer or group of engineers, may find or develop ways to better stabilize the foundations of freedom; to keep the conditions of freedom from undermining the acquired human characteristics on which it is based. That our mechanism of representative self-government and our character-building influences might *(Continued on page 568)*

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AGRICULTURAL ENGINEERING

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Strength of Nailed Joints in Frame Walls

By John A. Scholten and E. G. Molander

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IN ANY structure, the weakest parts are likely to be the joints. This is no less true for frame construction than for any other type. Necessarily then, if houses, barns, and other farm buildings are to be built better, one of the logical starting points for improvement is at the joints.

It is an acknowledged fact that wood-frame structures are built according to methods and rules worked out through long experience as to what will and will not serve the purpose. Size and spacing of members, spans, bracing requirements, etc, have all been established by cut-and-try methods. Buildings erected according to these rules, moreover, have on the whole given good service, which is precisely the reason why more exact designs based on engineering analysis of loads and other requirements have not been developed. Yet confusion and disagreement continue to exist as to the best methods of construction, particularly as to different ways of joining the framework.

This paper (revised and expanded) was presented at the annual meeting of the American Society of Agricultural Engineers at East Lansing, Mich., June, 1949, as a contribution to the Farm Structures Division.

The authors: JOHN A. SCHOLTEN, engineer, Forest Products Laboratory, Forest Service, U.S. Department of Agriculture, Madison, Wis., and E. G. Molander, engineer, farm building and rural housing division (BPISAE), USDA, Beltsville, Md.

AUTHORS' NOTE: Acknowledgment is made for the assistance of O. C. Heyer of the U.S. Forest Products Laboratory staff, who conducted the testing work.

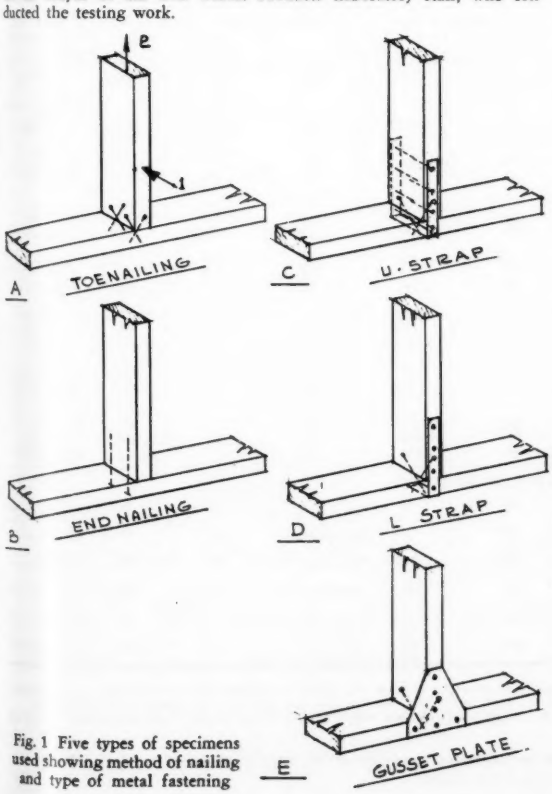


Fig. 1 Five types of specimens used showing method of nailing and type of metal fastening

To contribute positive information to this much debated subject of joint design, the Forest Products Laboratory, in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering, undertook, under the Research and Marketing Act, a fundamental study of nailed and strapped joints in frame walls, the results of which are reported here. The findings of this research are believed to give sound engineering guidance as to the comparative merits of two commonly employed methods of fastening studs to plates, toenailing and endnailing. For purposes of comparison, several variations of another type of joint, the metal-strap joint, were tested at the same time.

Types of Joints Tested. All joints tested were made from conventional 2x4-in studs and plates cut at the Laboratory from Douglas fir timbers. The test specimens were made of both green and dry material. The joints made of dry material were tested soon after fabrication, while half of those made of green material were tested immediately after fabrication and the other half after seasoning to a dry condition. An equal number of tests were made for each of the three seasoning conditions. By cutting the lumber at the Laboratory, matched material was obtained for specimens of each type and seasoning condition, thus eliminating possible variables in lumber quality. Common wire nails and 24-gage sheet-metal straps with an average maximum tensile strength of 1,083 lb per in of width were used.

The five types of joints tested are shown in Fig. 1. For joints A, the stud was toenailed to the sill with two 8d, 10d, or 16d nails through each wide face. Joint B was endnailed with two 10d, 16d, or 20d nails driven through the sill into the end of the stud. For joints C, D, and E, the stud was first toenailed to the sill with one 8d nail through each wide stud face, then the U strap, L strap, or gusset plate was nailed with 8d nails as shown in Fig. 1. The U and L straps were one inch in width. The U straps extended 6 in up each side of the plate and stud, whereas the L strap extended 2 in under the plate and 6 in up one side of the plate and stud. The gusset plate was 5 in wide at the bottom and tapered to a width of 1⅝ in at a height of 6 in.

In the toenailed joints, the nails were driven at a 30-deg angle from the upright framing member or stud, and the end distances for the various sizes of nails were as follows: 8d, ¾ in; 10d, 1 in; and 16d, 1½ in. Previous exploratory tests have shown that a nail slope of 30 deg, together with an end distance (distance from end of member at which nail is started) of approximately one-third the length of the nail, provided a satisfactory combination for joints subjected to tension and lateral loads.

Methods of Test. In frame buildings, joints are subjected to lateral loads, tension loads, or a combination of the two. The extent to which a particular joint in a structure is affected by either load depends considerably, of course, on the loading conditions in the structure and on its location, as well as on such parts as sheathing and siding. Since all such variables cannot be included in a testing program, the tests were confined to determining the effect of differences in the strength of joints when the load is applied either laterally or in tension. Each specimen was, in addition, given standard tests for specific gravity and moisture content.

The lateral-load test was designed to simulate loads imposed on a building principally by wind or by the thrust from

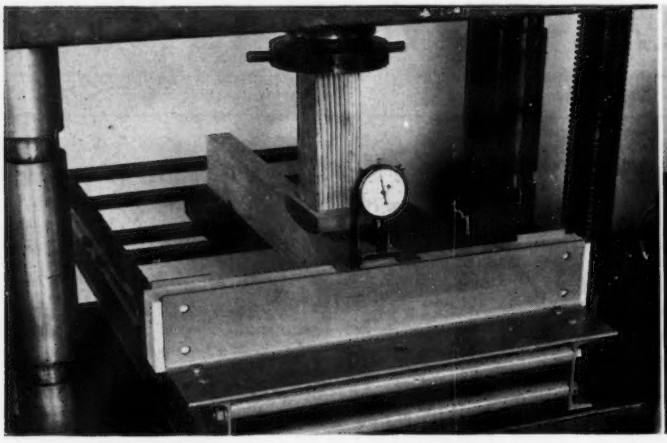


Fig. 2 *(Left)* Test specimen and machine setup for lateral load test

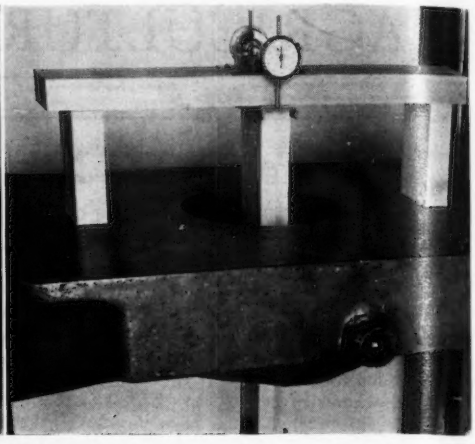


Fig. 3 *(Right)* Test specimen and machine setup for tension test

grain in a bin. The specimen was placed in a testing machine (Fig. 2) with the sill member supported at two points 20 in apart. A rigid frame kept it from tipping as the load was applied. Load was applied to the stud at a point 6 in from the sill and at a rate of 0.0125 in per min. Deflection or slip of the stud-to-sill joint was measured with a dial gage at various loads.

The tension test was planned to simulate principally uplift loads. The specimen was placed in a testing machine (Fig. 3) with the sill member supported at two points 20 in apart. Load was applied to the free end of the vertically positioned stud at a speed of 0.0125 in per min. Deflection, or slip, of the stud-to-sill joint was measured with a dial gage at various loads.

The loads were recorded at various increments of slip and at the maximum. The maximum load is important in that it provides a measure of the load which can ultimately be sustained by the joint. The loads at various slips of the joint, particularly at 0.015 in, however, provide a criterion of comparison when the amount of permissible distortion in a joint is limited.

Results of Tests. The tests permitted direct comparison of the three types of joints, toenailed, endnailed, and strapped. In addition, it was possible, from the test data, to evaluate

Table 1.--Strength of stud-to-sill joints in Douglas-fir lumber[1]

Type of fastening	Type of test	Nails used in assembly[2]		Joints fabricated dry -- tested dry			Joints fabricated green -- tested green			Joints fabricated green -- tested dry		
				Load at 0.015-inch slip	Maximum		Load at 0.015-inch slip	Maximum		Load at 0.015-inch slip	Maximum	
		Nail size	Number		Load	Slip		Load	Slip		Load	Slip
		Penny		Pounds	Pounds	Inch	Pounds	Pounds	Inch	Pounds	Pounds	Inch
Toenailing	Lateral[3]	8	4	337	872	0.23	247	595	0.16	247	786	0.17
Do	do	10	4	424	815	.08	318	686	.14	308	786	.12
Do	do	16	4	487	1,065	.22	361	796	.08	306	1,061	.40
End-nailing	do	10	2	231	684	.43	232	522	.62	159	614	.48
Do	do	16	2	322	682	.39	293	700	.51	192	.741	.38
Do	do	20	2	412	839	.62	431	660	.27	223	699	.26
L-strap	do	8	4	282	1,006	.60	133	957	.48	129	885	.75
U-strap	do	8	8	244	1,450	.35	193	1,626	.40	118	1,641	.50
Gusset	do	8	6	230	1,062	.65	155	1,046	.72	137	935	.....
Toenailing	Tension[3]	8	4	365	452	.15	435	508	.10	234	605	.18
Do	do	10	4	665	816	.11	526	795	.19	272	865	.33
Do	do	16	4	584	871	.20	787	1,032	.19	406	1,028	.23
End-nailing	do	10	2	.....	310	.02	.....	224	.01	104	128	.13
Do	do	16	2	.....	211	.01	.....	346	.01	139	163	.27
Do	do	20	2	499	518	.02	.....	593	.01	166	225	.43
L-strap	do	8	4	233	733	.34	303	763	.28	173	802	.34
U-strap	do	8	8	855	2,308	.33	745	2,054	.32	300	1,813	.39
Gusset	do	8	6	330	971	.14	457	1,008	.12	161	1,113	.31
Average Loads in Percent of Those for Dry Material												
Toenailing	Lateral	8, 10, 16		100	100	.....	74	76	.....	70	95	.....
End-nailing	do	10,16, 20		100	100	.....	99	86	.....	61	94	.....
Straps and plate	do	8		100	100	.....	64	102	.....	51	96	.....
Toenailing	Tension	8, 10, 16		100	100	.....	111	109	.....	58	119	.....
End-nailing	do	10,16, 20		100	100	.....	.....	117	.....	.....	50	.....
Straps and plate	do	8		100	100	.....	118	99	.....	53	101	.....

1 All material was cut from one log. All specimens were nominal 2- by 4-inch clear stock and matched for three conditions of moisture and side matched for different types of joints. The average specific gravity (based on oven-dry weight and volume at test) was 0.427, and the moisture content 10.1 percent, for the joints fabricated dry and tested dry; respective values were 0.394 and 32.6 percent for the joints fabricated and tested green; and 0.426 and 11.8 percent for the joints fabricated green and tested dry.

2 When metal straps or gusset plates were used the stud was first positioned on the sill by toenailing one eightpenny nail on each wide face of the stud.

3 Each value is the average of three tests.

the effect of size of nail on the toenailed and endnailed joints and the three types of strapping used on the strapped joints.

In evaluating data from tests of joints and fastenings, a factor must be considered that is not involved in conventional strength tests of materials. This factor is the amount of slip that occurs during the test between the two members joined together. Slip is, in a sense, comparable to deflection in standard load-deflection tests of materials, yet it does not, because of the influence of the fastenings, submit so easily to analysis. Results of tests of various joints at the Forest Products Laboratory have, however, given reliable information on the relation between amount of slip and load at proportional limit. *In general, it can be assumed that proportional limit for a nailed joint is reached at a slip of about 0.015 in.*

In Table 1 are summarized the test data obtained for the three general types of joints and for various sizes of nails in toenailed and endnailed joints. Both the load at a slip of 0.015 in (assumed to be the proportional limit) and maximum load are given. It will be noted that, in all cases except tension loading of endnailed joints, slip at maximum load was considerably greater than 0.015 in. Composite load-slip curves showing the movement in the joint at different loads for the various types of joints are given in Figs. 4 and 5.

In general, comparisons made in this discussion pertain to joints made of dry material and tested soon after assembly. Data, however, are also provided in Table 1 and presented graphically in Fig. 6 on the strength of joints made of green material and tested soon after assembly or after the joints had

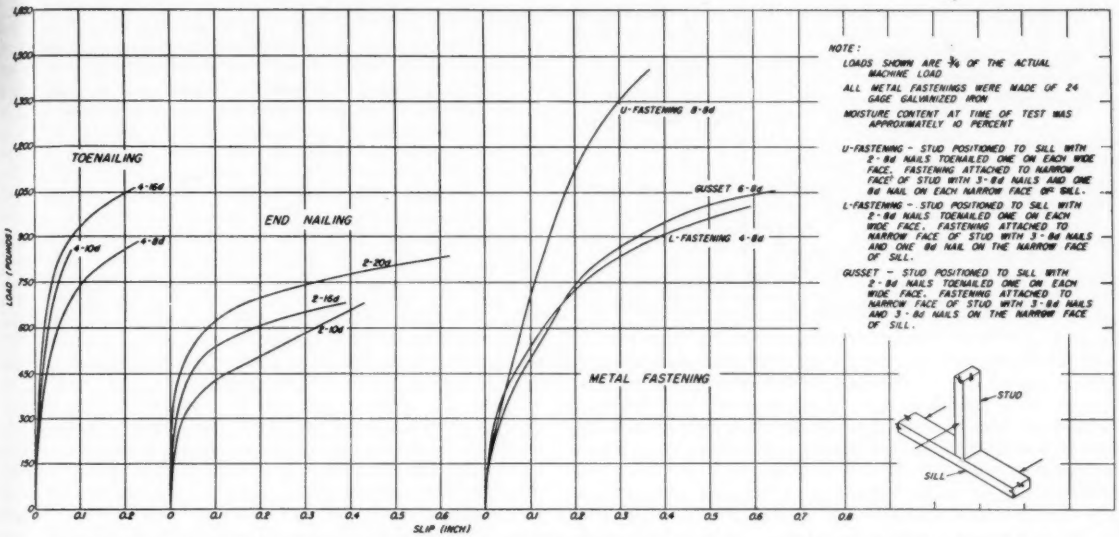

NOTE:
LOADS SHOWN ARE 1/10 OF THE ACTUAL MACHINE LOAD
ALL METAL FASTENINGS WERE MADE OF 24 GAGE GALVANIZED IRON
MOISTURE CONTENT AT TIME OF TEST WAS APPROXIMATELY 10 PERCENT
U-FASTENING - STUD POSITIONED TO SILL WITH 2-8d NAILS TOENAILED ONE ON EACH WIDE FACE. FASTENING ATTACHED TO NARROW FACE OF STUD WITH 3-8d NAILS AND ONE 8d NAIL ON EACH NARROW FACE OF SILL.
L-FASTENING - STUD POSITIONED TO SILL WITH 2-8d NAILS TOENAILED ONE ON EACH WIDE FACE. FASTENING ATTACHED TO NARROW FACE OF STUD WITH 3-8d NAILS AND ONE 8d NAIL ON THE NARROW FACE OF SILL.
GUSSET - STUD POSITIONED TO SILL WITH 2-8d NAILS TOENAILED ONE ON EACH WIDE FACE. FASTENING ATTACHED TO NARROW FACE OF STUD WITH 3-8d NAILS AND 3-8d NAILS ON THE NARROW FACE OF SILL.
TOENAILING
4-16d
4-10d
4-8d
END NAILING
2-20d
2-16d
2-10d
U-FASTENING 8-8d
GUSSET 6-8d
L-FASTENING 4-8d
METAL FASTENING
STUD
SILL
LOAD (POUNDS)
SLIP (INCH)

Fig. 4 Relation between load and slip for various types of stud-to-sill joints made with dry material and subjected to lateral loads. (Each curve is the average of 3 tests)

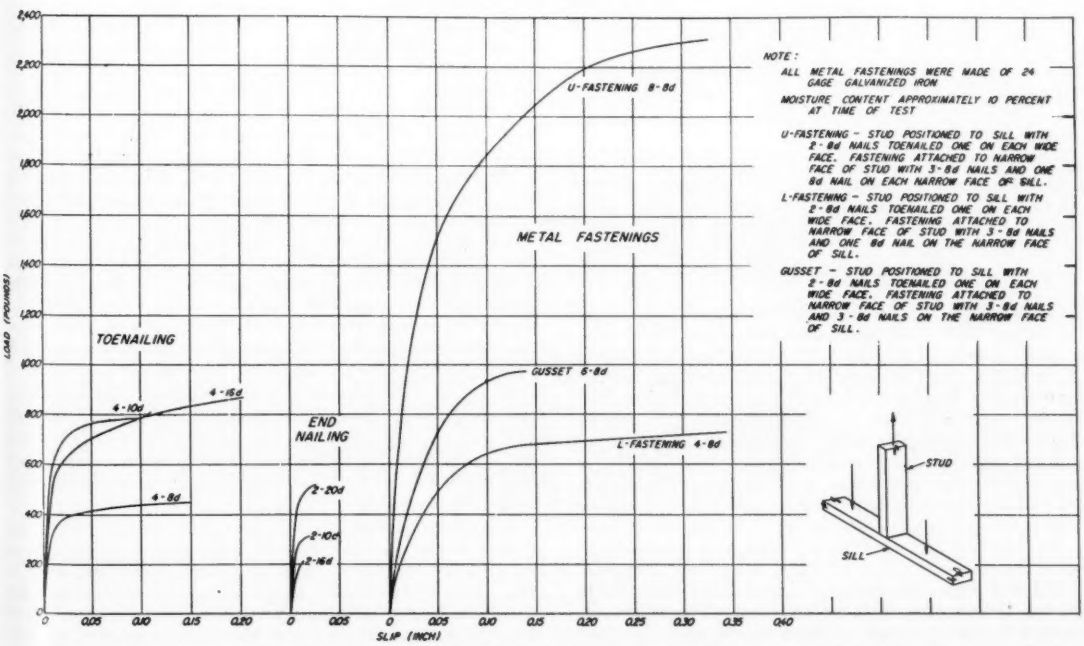

NOTE:
ALL METAL FASTENINGS WERE MADE OF 24 GAGE GALVANIZED IRON
MOISTURE CONTENT APPROXIMATELY 10 PERCENT AT TIME OF TEST
U-FASTENING - STUD POSITIONED TO SILL WITH 2-8d NAILS TOENAILED ONE ON EACH WIDE FACE. FASTENING ATTACHED TO NARROW FACE OF STUD WITH 3-8d NAILS AND ONE 8d NAIL ON EACH NARROW FACE OF SILL.
L-FASTENING - STUD POSITIONED TO SILL WITH 2-8d NAILS TOENAILED ONE ON EACH WIDE FACE. FASTENING ATTACHED TO NARROW FACE OF STUD WITH 3-8d NAILS AND ONE 8d NAIL ON THE NARROW FACE OF SILL.
GUSSET - STUD POSITIONED TO SILL WITH 2-8d NAILS TOENAILED ONE ON EACH WIDE FACE. FASTENING ATTACHED TO NARROW FACE OF STUD WITH 3-8d NAILS AND 3-8d NAILS ON THE NARROW FACE OF SILL.
U-FASTENING 8-8d
METAL FASTENINGS
GUSSET 6-8d
L-FASTENING 4-8d
TOENAILING
4-10d
4-16d
4-8d
END NAILING
2-20d
2-10d
2-16d
STUD
SILL
LOAD (POUNDS)
SLIP (INCH)

Fig. 5 Relation between load and slip for various types of stud-to-sill joints made with dry materials and subjected to tension loads. (Each curve is the average of 3 tests)

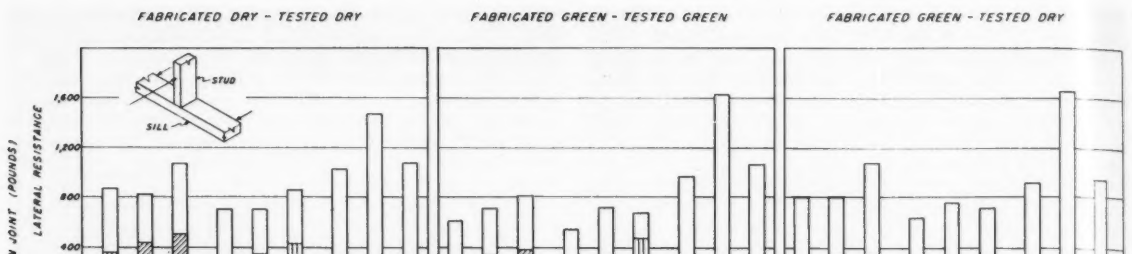


Fig. 6 Relationship between loads for various types of stud-to-sill connections fabricated from Douglas fir at three different moisture conditions. (Stud positioned to sill by toenailing with two 8d nails in all joints with metal fastenings)

seasoned to show its relationship to the strength of joints made of dry material. Actual photographs of specimens showing how they failed in tests are presented in Figs. 7 to 12.

The values given in Table 1 show that the highest maximum loads were carried by the U-strapped joint, but at a high slip as compared with the toenailed and endnailed joints. Maximum load is, of course, the criterion of structural safety, and on this basis the U-strapped joint is easily the best. The relatively high slip, however, accompanying these high loads would result in obvious structural distortion and give a building the appearance, at least, of being unsafe. It is for this reason, in fact, that the proportional limit load is set at a slip of not greater than 0.015 in, since tests have shown that loads sufficient to cause this slip result in little, if any, noticeable permanent distortion.

With one exception, toenailing gave higher proportional-limit loads—load at slip of 0.015 in—than any other method of fastening. The single exception was the U-strap joint tested in tension. On the other hand, the U-strap joint, when tested for lateral load, was inferior to all three toenailed joints and to the endnailed joints nailed with 16d and 20d nails.

The U-strapped joint was distinctly superior to other strapped types. The L-strapped and the gusset-plate joint carried, with a single exception, maximum loads that were equal to or higher than those for the toenailed joints but the slip accompanying the maximum loads was much higher than that for the toenailed joints. In evaluating the strength of joints fabricated with metal straps it should be remembered that in these joints the stud was also fastened to the sill by toenailing with two 8d nails (Figs. 1, 9, and 12). These nails provided much of the rigidity under small loads since the lateral loads of strapped joints at 0.015-in slip were only slightly greater than half the load obtained in a conventional toenailed joint made with four 8d nails. It appears, however, that for unusual service conditions where high maximum loads are required, U strapping is to be preferred. The additional cost involved in making strapped joints can be partially offset by using them in conjunction with toenailing on every other or every third framing member.

The superiority of toenailing to endnailing is obvious from Table 1 and Fig. 6. Methods of making nailed joints vary, but in practice two nails are commonly used when the nails are driven through the sill or plate into the ends of the studs. In toenailing good practice requires two nails on each wide face of the stud. In this investigation the toenailed joints were assembled with 4 nails (Figs. 1, 7, and 10) and the endnailed joints with 2 nails (Figs. 1, 8, and 11). A comparison of the two, particularly of the joints toenailed with 8d nails and those endnailed with 16d nails (the two sizes ordinarily used for the two types), shows that toenailed joints in dry material consistently carried higher loads at both proportional limit and maximum. With endnailing, the movement of the stud with respect to the base plate is less than with toenailing, but this is largely offset by the greater slip or movement at lower maximum lateral loads. Furthermore, in the endnailed joint the carrying capacity in tension is negligible after the maximum load has been reached, while the toenailed joint retains considerable capacity after the maximum load has been reached in spite of more pronounced splitting. Since, under actual service conditions, stud-to-sill joints are probably subjected to combinations of the two types of loading, toenailing would appear to offer the greater stability. Greater care is required in making toenailed than other types of joints, however, since much of the superiority of toenailing can be lost by using improper nailing angles and end distances.

In Fig. 4, 5, and 6 the different types of joints are compared graphically. Toenailing shows to advantage, especially under lateral load (Fig. 4), over all but U-strapped joints. The failures for the different types of joints under lateral loads are shown in Figs. 7, 8, and 9, and under tension loads in Figs. 10, 11, and 12.

In comparing the toenailed joints made with the three sizes of nails in dry material, it is apparent that those made with 10d nails are markedly superior to those fastened with 8d nails. This superiority is significant in view of the fact that most light frame buildings have such joints made with 8d nails. In the lateral-load test, the joints toenailed with 8d nails carried 337 lb at proportional limit, while those toenailed with 10d nails carried 424 lb on the average. In the tension

test, the 10d nails had an even greater advantage at proportional limit, 665 lb as compared with 365 lb for the 8d nails. At maximum lateral load, the joints with 8d nails carried 872 lb as compared with only 815 lb for those with 10d nails; this was in large part offset, however, by the much greater slip recorded for the joints with 8d nails. At maximum tensile load, the joints toenailed with 10d nails were unquestionably superior, taking 816 lb as compared with 452 lb for the joints with 8d nails and with less slip, 0.110 in as against 0.148 in. The joints toenailed with 16d nails gave even better test values than those with 10d nails, but the added superiority is not so marked and the tendency to splitting is greater (Figs. 7 and 10). On the basis of these tests, the joints toenailed with 10d nails appear, on the whole, to best advantage. This is borne out more plainly in Figs. 4 and 5.

The results of the tests of joints fabricated of green material and tested immediately or after seasoning are included in Table 1 with those of dry material. It will be noted that in the toenailed joints made with green material the maximum loads, as with dry material, increased with an increase in size of nail from 8d to 16d, both under tensile and lateral loads. In the endnailed joints the maximum tension loads also increased as the nail size was progressively increased from 10d to 16d to 20d, but under lateral load, the maximum values for the 20d were somewhat less than for the 16d nail.

The average ratio of the values for joints made of green material tested immediately and after seasoning in per cent of those for dry material is given at the bottom of Table 1. Material which is fabricated green will usually season in service. The values for the joints made of green material and seasoned before test are, therefore, more significant than those which were tested green. Considerable separation had developed in these joints during the seasoning period. The loads obtained at small distortions, therefore, were much less than those previously obtained for joints of green or dry material. The loads at 0.015-in slip averaged from 50 to 70 per cent of those obtained for dry material, the reduction in load for toenailed joints being somewhat less than for the other types of joints. The maximum loads, however, compared favorably with those obtained for dry material for all joint types excepting endnailed. The lateral resistance of the endnailed joints was quite satisfactory, but the joints were decidedly lacking in tensile strength.

CONCLUSIONS

The U-strapped joints were distinctly superior at maximum loads to any of the other types of joints tested but the slip accompanying the maximum loads was relatively large.

Of the two conventional types of joints, those toenailed with four 8d nails were superior to the joints endnailed with two 16d nails.

The strength of the toenailed joint can be increased considerably by using 10d instead of the commonly used 8d nails.

Splitting of the wood was more noticeable in the toenailed joints, but the detrimental effect was not so severe as when splitting occurred in an endnailed joint. (The value in tension given in Table 1 for the joint endnailed with 16d nails would be about 390 instead of 211 lb if splitting had not occurred.)

The maximum loads for the strapped joints are in general obtained at a much greater slip or distortion than occurs in the toenailed joints.

The toenailed and strapped joints still retain considerable strength in tension after the maximum load is reached. In the endnailed joint the maximum load is reached at a comparatively small distortion but thereafter the carrying capacity of the joint is negligible.

Toenailing requires greater skill in assembly than other types of joints. The results in this investigation are based on toenailed joints made by an experienced carpenter.

The initial distortion under lateral loads of metal-strapped joints is greatly reduced when the metal strapping is supplemented with toenailing.

Considerable separation developed in joints made of green material and seasoned before test, and the loads at small distortions were much less than those obtained for joints of green or dry material. The maximum loads, however, compared favorably with those obtained for dry material for all joints except end nailing in tension tests, where the loads were about half those obtained with dry material.

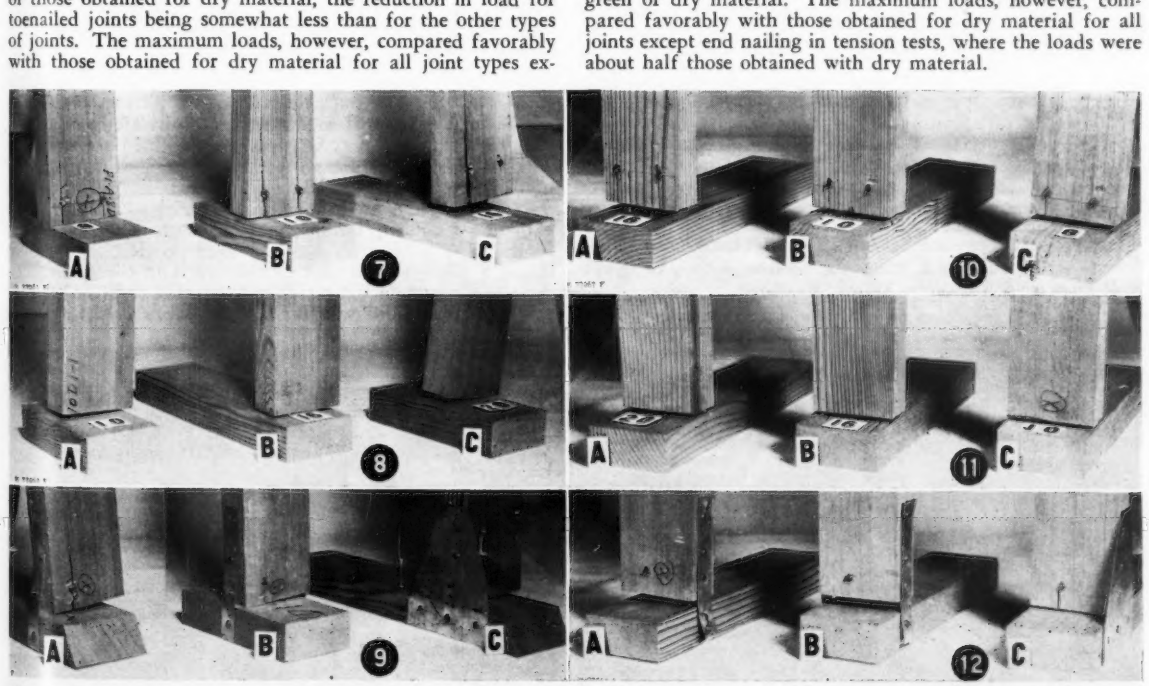


Fig. 7 Typical failures of toenailed joints after lateral load test. The joints were fabricated from dry Douglas fir and toenailed with 8d, 10d and 16d nails • Fig. 8 Typical failures of endnailed joints after lateral load tests. The joints were fabricated from dry Douglas fir and endnailed with 10d, 16d and 20d nails • Fig. 9 Typical failures of metal-strapped and gusset joints after lateral load tests. The joints were fabricated from dry Douglas fir and the stud attached with L or U straps or gusset plates • Fig. 10 Typical failures of toenailed joints after tension tests. The joints were fabricated from dry Douglas fir and toenailed with 8d, 10d and 16d nails • Fig. 11 Typical failures of endnailed joints after tension tests. The joints were fabricated from dry Douglas fir and endnailed with 10d, 16d and 20d nails • Fig. 12 Typical failures of metal-strapped and gusset joints after tension tests. The joints were fabricated from dry Douglas fir and the stud attached with L or U straps or gusset plates

Fertilizer Placement Machine for Experimental Plot Work

By Gustave E. Fairbanks
MEMBER A.S.A.E.

RESEARCH work on the effect of commercial fertilizers has been difficult and results have often been erratic because of the lack of accurate placement equipment. This article is devoted to a description of the accurate fertilizer placement machine shown in Figs. 1 and 2 which was built by the agricultural engineering department of Kansas State College for use by the agronomy department.

The Kansas State fertilizer placement machine was patterned in part after a machine(1)* developed jointly by the Texas Agricultural Experiment Station and the Mississippi Delta Branch Experiment Station, which employed a belt feed principle used on an earlier machine built by J. P. Fairbank and P. A. Minges of the University of California(2).

The Kansas State machine is similar in some respects to the USDA radioactive phosphate fertilizer hopper machine described in AGRICULTURAL ENGINEERING for June, 1950 (3). It was not designed to handle radioactive material, and unlike the USDA machine does not have a stationary hopper or an endless belt. It uses a rotating-brush feed to insure uniform fertilizer distribution.

The Kansas State machine is mounted on an International Harvester Model C tractor in connection with a C-221 corn planter. The corn planter is equipped with special split-runner-type furrow openers capable of making fertilizer applications to a depth of 6 to 8 in. Fertilizer and seed fall through separate flexible tubes and are placed separately by the split-runner-type furrow openers.

The Kansas State machine is a two-row machine capable of placing predetermined amounts of three separate fertilizers simultaneously on any length of test-plot row from 44.9 to 719 ft without premixing. Any two of a set of thirteen sprockets can be interchanged on a jackshaft to give 156 different lengths of test-plot rows within the limits stated above. A screw-controlled slide, as shown in Fig. 2, hinged at one end supports the jackshaft thus providing a quick, easy method of adjusting proper chain tension each time a change of sprockets is necessary. The proper choice of sprockets causes the three-compartment bottomless fertilizer hoppers to move a distance equal to their own effective length by the time the machine has traversed the desired length of test-plot row. The fertilizer hoppers are 28 in long, 16¼ in wide, and 4¼ in deep. The individual compartments are each 4¾ in wide.

The brushes which are rotated in each compartment are 10½ in in diameter with a hub 4½ in long. The front end of the fertilizer hopper is curved to fit the curvature of the brushes so that all of the fertilizer will be swept from the compartments.

A pair of rollers, 6½ in in diameter and 16¾ in long, support each belt on which the fertilizer hoppers ride. A piece of masonite under the upper side of the belt supports the weight of the hopper. The center to center distance between the rollers is 26 in. The roller axles work in oilite bearings. Only the action of the fertilizer hoppers being pulled into the brushes causes the belts to move and the rollers to rotate.

The framework which supports the rollers is extended 22 in to the rear of the back roller, thus providing a platform for the fertilizer hoppers to rest on as they reach the rearmost extent of their movement. The screw-controlled hinged jackshaft support mentioned earlier is fastened to the framework of the left unit.

Power to operate the fertilizer placement machine comes from a sprocket on the main axle of the tractor. This sprocket drives a jackshaft which in turn drives the shaft upon which the brushes are mounted. The six brushes are 10½-in fiber-bristle brushes with a wooden hub 4½ in in diameter. The brushes just fit into the 4¾-in wide compartments of the hoppers.

Pinions on the ends of the brush shaft work in a rack attached to each three-compartment bottomless hopper and cause the hoppers to be pulled into the brushes. The racks are attached to the fertilizer hoppers by hinged parallel links as shown in Fig. 2. A spring and the turning action of the pinion keeps the rack firmly in mesh with the pinion. After each run the racks are swung down out of mesh with the pinions while the fertilizer hoppers and belts are being pulled back to the starting position. The hoppers ride on a wide belt which forms the bottom of each three-compartment hopper until the belt breaks over the rear roller. When this happens, the fertilizer from each compartment begins to fall down the gathering spout into the flexible tube which delivers it to the runner. The brushes revolve in a fixed position and help to insure a positive even feed of fertilizer into the spout. The three separate kinds of fertilizer are mixed together as they fall down the collector spout and *(Continued on page 564)*

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

The author: GUSTAVE E. FAIRBANKS, associate professor of agricultural engineering, Kansas State College, Manhattan.

*Numbers in parentheses refer to the appended references.

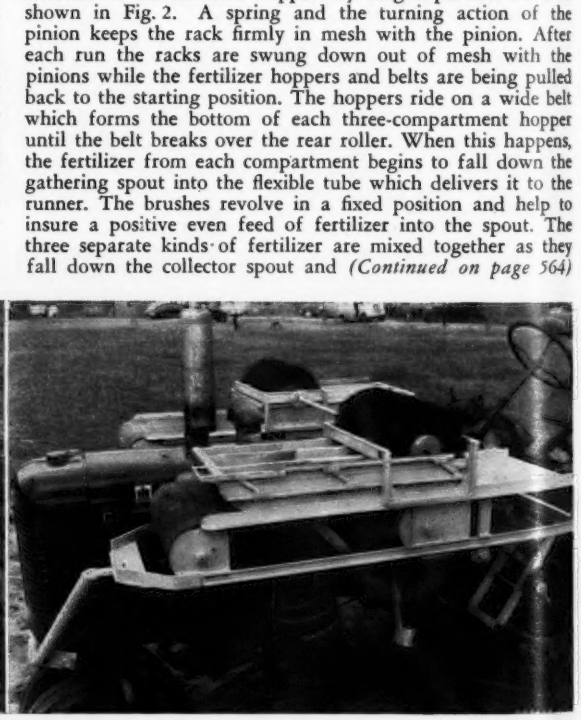


Fig. 1 *(Left)* Front view of Kansas State fertilizer placement machine showing the method in which it is mounted on tractor in conjunction with a 2-row corn planter • Fig. 2 *(Right)* Side view of the same machine showing the hinged parallel linkage which fastens the racks to the movable hoppers. The hinged screw-controlled slide which supports the jackshaft is shown in the lower right-hand corner

Engineering an Automatic Hay Baler

By George B. Hill
MEMBER A.S.A.E.

ONE of the most popular methods of putting up hay today is baling. Of the 100 million tons produced last year, approximately one-half was baled, and a large portion of this was packaged with pickup balers. While there is some hay still baled from the stack in stationary balers, the same as in years past, it was the development of the automatic pickup baler that was instrumental in swinging the farmer to the idea of baling.

This idea, however, is not new in the United States and I would like to review some of the highlights of the history of baling and baling activities, which laid the groundwork for the modern-day automatic baler. As early as 1813, according to the records of the U.S. Patent Office, a patent was issued to a Mr. Thorn of New York City on a hay press. There are several other patents granted in the early part of the nineteenth century. Of course it is true that some of these patents covered machines that would bale cotton, straw and other materials as well as hay. But nevertheless, hay baling even at that time was a reality.

History indicates that the first practical hay baler was designed around 1850. During the period between 1850 and 1870, most of the balers were upright or perpendicular box presses, forming large cumbersome bales which were often tied with wooden hoops. These bales could be handled only by rolling them on the ground. The feeding operation required a lot of shaking to loosen the compressed mass of hay.

In the actual development of early balers, the West Coast and East Coast were working on baling ideas simultaneously. The need for hay balers came from the necessity of transporting feed along the various stagecoach, freight and pony-express routes in the West.

In 1872, a Mr. Dederick of Albany, New York, introduced a "perpetual" baler. He claimed it was the first successful horizontal baler and the first to pack and complete a bale in charges with continuous reciprocating travel. This machine sold to farmers from $250 to $300.

About this same time, Jacob Price started a company in San Leandro, Calif., to manufacture hay presses. It was known as Price's upright press and it was claimed that its capacity was 15 to 20 tons of hay per day. These old-fashioned upright presses were called "muzzle loaders" and "sweat boxes" because the operator had to labor strenuously to tramp the hay into the baling chamber before it was compressed with the plunger. Price later designed several balers with a beater. This replaced the tramper with a large block which packed each successive forkful of hay by falling on it like a pile driver. This was the forerunner of the wadboard.

Price's final baler was the Hurricane—a portable, horizontal, top feed baler capable of baling 40 tons of hay per day. The Hurricane was known as a "double ender", having the power applied at the center and pressing a bale at each end.

The Vandiver Corn Planter Co. of Quincy, Ill., produced a baler in the 1880's. It was said to be the first to incorporate a compacting device consisting of simple tension rods which did away with the springs and similar devices used on the bale chamber of other balers.

Fairbanks, Morse & Company, Chicago, built the Eclipse baler having the first automatic folding device for folding hay down into the baling chamber. It was identical to the present wadboard. Horsepower was used on all of these balers, with one or two horses hitched to a long lever pole called a sweep. The horses traveled in a circle to operate the compression chamber. Balers of this same design are still built and sold in the South.

The Wright Brothers obtained a patent on a hay baler in 1878 which was a combination hay rake and baling press. This was the forerunner of the pickup balers which we now see. A man in Arkansas also obtained patents in 1907 on a combination hay gatherer and press.

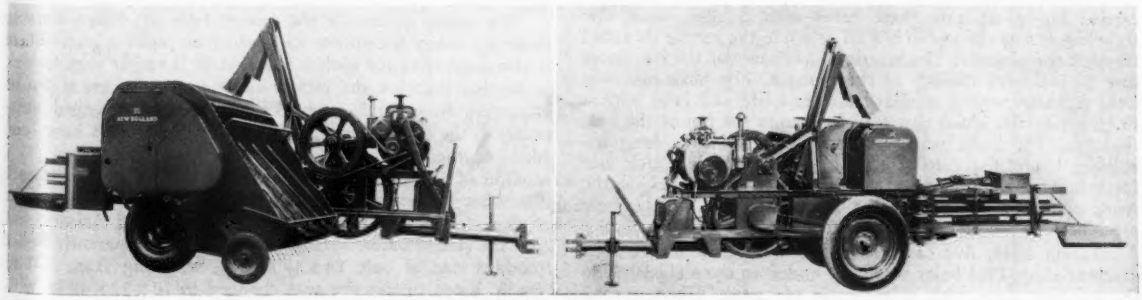
The demand for greater baling capacities led to the application of steam power to the old horse-powered balers. Later the development of the gasoline engine made it possible to mount an engine on the frame of the baler and transmit the power from the engine to the baler with a belt. This made possible balers that were less cumbersome and easier to move around.

It was not until about 1930 that any great amount of development work was done on field pickup baling. Among others, the Ann Arbor Machine Co. introduced a pickup baler in 1930. These first pickup balers required three or four men to operate them in the field. Besides the tractor operator, one man was required to handle the blocks used to separate the bales, and two men were required to feed and tie the wires. And it usually required one man on the cross feed to make sure that the hay was placed under the wadboard so that it could be pushed down into the bale chamber. The Ann Arbor machine was described as a tractor-drawn and tractor-powered baler with a pickup attachment similar to that used with grain combines.

In 1933, MacGregor and Richardson obtained patents purchased by the J. I. Case Co. These covered a flexible, mounted pickup which was self-adjusting to follow variation in ground level encountered in field operations. About this same time, John Deere also obtained patents covering a baling action which made it possible to have the plunger head stay in the open position longer so there was more time to feed hay into the baling chamber.

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at Washington, D.C., June, 1950, as a contribution of the Power and Machinery Division.

The author: GEORGE B. HILL, chief engineer, New Holland Machine Div., The Sperry Corp., New Holland, Pa.



These two views of the New Holland automatic baler, Model 77, illustrate the advancement that have been made since the first automatic baler was introduced 10 years ago. This model features a large floating pickup, 20 per cent fewer parts, and a capacity up to 7 bales per minute.

Although the pickup balers were all hand-tie machines, they apparently were the forerunners of the present automatic machines. In checking back through the patents on balers, we find a few patents issued before 1880 and a large number of patents issued between 1880 and 1930 on both automatic wire-tie and twine-tie machines. Yet there were no machines on the market doing a successful job of automatically tying either wire or twine. Actually the demand for automatically tying the bale was becoming increasingly great among the farmers. It was this stimulus which produced the first successful automatic baler. Since that baler was the forerunner of the New Holland baler, I would like to take a few minutes to tell about the way it came into existence.

During the summer of 1936, Ed Nolt, a Lancaster County, Pa., farmer who operated a threshing rig on a custom basis, tried several automatic twine-tie balers in his operation. He found these balers did a very poor job of baling, so at the end of the threshing season, he set out to improve their design in his Farmersville, Pa., garage. In early 1937, the forerunner of the modern New Holland baler emerged from this garage. This early baler was a mixture of parts of other balers, wood saws, grain combines, Fordson tractors and parts of Mr. Nolt's own design and construction. A metering wheel was used to measure the length of the bale. When the proper length of bale was attained, the metering wheel tripped a mechanism stopping the feed mechanism and allowing the plunger to make three strokes to clean out the bale chamber before the knot was tied. The feeder was then engaged and the hay was again fed into the baler. During the tying cycle, hay was not fed in for about three to four strokes of the plunger cutting the capacity of this machine considerably. The bales made were very loose because they were not tied under compression.

When this machine was used to do custom baling in the season of 1937, field tests showed up additional difficulties. A standard grain combine pickup had been used on the baler. The operator soon found the pickup cylinder wrapped badly in certain types of hay. Trouble was also encountered with the pickup and crossfeed in getting the material to move across uniformly, and getting the material in under the wadboard so that it could be compressed. Some tying trouble was also encountered because a standard binder knotter was used.

WORK ON NOLT BALER CARRIED FORWARD

At the end of the season of 1937, Mr. Nolt took his baler apart and decided to abandon the project because of the difficulties. Some of his friends, however, persuaded him to keep on going. One of these was Arthur Young who had a machine shop in Kinzer, Pa. He persuaded Mr. Nolt to try building several new machines for the coming year. Early in 1938, five balers were built in Kinzer. On these machines the plunger head was stopped during the tying cycle so that the hay was held under compression until tied. The needles traveled through grooves in the plunger head, overcoming the difficulty encountered in the previous model. The wadboard action was also changed so that it would push the hay in slowly and then retract rapidly. An auger was then added to the cross feed to make sure the hay was pushed under the wadboard.

With the bales tied under compression, there arose the problem of separating the bales. The first experiments were carried on to separate these bales with a 10-in buzz saw traveling across the top of the baler while the needle threaded through the plunger. The rotating buzz saw cut the hay loose that lapped over the top of the plunger. The buzz saw was later replaced with a standard mower knife and later with a single triangular blade that traveled across the top of the bale chamber. The knife was further developed into a long triangular blade, the cutting edge of which traveled back and forth in a small groove on top of the plunger following the tying operation. This was the knife installed on the new machine.

During 1938, five of these balers were built in Young's machine shop. One baler was kept under an open shed beside the machine shop with a large pile of straw. When anyone came to see the baler, they were given a demonstration of it actually baling straw. These 5 balers were kept busy doing custom baling during that summer. Mr. Nolt still continued with his threshing rig on a custom basis.

Thirty balers were built in Young's shop in 1939 and 90 in 1940. The last 10 of the machines built in 1940 had a newly designed pickup which was basically the same as the pickup used on the Model 76 New Holland baler.

In the fall of 1940, Mr. Nolt concluded an agreement with the newly reorganized New Holland Machine Co. Shortly afterwards, the production of the automatic baler was moved to the New Holland plant. That baler was then put into mass production and manufactured until the fall of 1949. Although this was essentially the same machine as the last ten produced at the Kinzer plant, there were many minor changes and improvements made during the time it was in production. Changes such as the addition of a shear bar on the plunger head to replace the triangular knife.

NEW HOLLAND ENGINEERS REDESIGN BALER

In 1947, Mr. Nolt, along with the New Holland engineers, started to redesign the baler to simplify and improve it functionally. Tests were made on the new model in 1947, 1948 and 1949, and, as a result, late in the fall of 1949 a new baler known as Model 77 was put into production. The main improvements on this machine over the previous model were that the knotters were inverted to keep the dirt and chaff out of the gears; the pickup was put on the opposite side of the machine; and the canvas pickup conveyor was eliminated. During the tests conducted on this machine, a constant effort was made to improve the performance of the baler.

At the same time, New Holland was aware that there is a demand for a wire-tie baler. Work was started on such a machine in about 1942 and 1943. Jesse Haase of Martinsville, Ind., who had developed a wire-tie mechanism, made arrangements with the New Holland Machine Co. to use the mechanism. Considerable amount of development work had to be done in adapting this mechanism to the type of baler New Holland wanted to build. As the tests progressed on this machine, improvements were made. After about 7 years of extensive testing and redesigning, a very limited number of wire-tie balers were put on the market this year. These balers have been working very well.

In the development work on any agricultural machine, it seems to take a considerable amount of time to perfect it. The machine cannot be just thought of, built, and put into quantity production. There are many different conditions under which a machine must work. The ground conditions, such as sand, terrain and soil, the climate, and the condition and type of hay all have a bearing on the performance of a baler.

In developing any new equipment, there are two procedures to follow. One is to develop a product that is radically different from machines already on the market. For this the engineer first has to get an idea for a machine, develop it, and then create a need for such a machine.

The second procedure is to develop a machine that is similar to a machine already on the market. For this, an individual can look at existing models of the machine and locate the difficulties, and then set out to improve it by overcoming the difficulties and by adding new features to make it perform still better.

The latter is usually the easiest type of design because there is already something with which to make a start. There is also a demand for such a machine. It is rather easy to look at another machine and pick it apart and see where it can be improved. In general, baler designs have not changed drastically in the last 50 years, but many improvements have been added to them.

One of the engineer's problems is convincing the farmer that what he designs is what should be used. As an example of this, one of the problems in California and Arizona has been the size of bales. Several years ago they apparently had a standard size of bale 24 x 30 x 48 in, weighing from 300 to 500 lb. Later on this size was changed to 18 x 22 x 40 in with the bale weighing about 150 to 165 lb. Nearly all the hay buyers and most of the truckers *(Continued on page 564)*

Techniques for Drainage Investigations in Coachella Valley, Calif.

By J. S. Reger, A. F. Pillsbury, R. C. Reeve and R. K. Petersen
MEMBER A.S.A.E. MEMBER A.S.A.E.

A WATER supply is being brought into Coachella Valley, California, from the Colorado River. With the completion of the Coachella branch of the All-American Canal, and with the construction of a distribution system, which is now in progress, this supply will make possible an increase of the irrigated acreage from about 17,000 acres in 1936 to an estimated 75,000 acres in the future. Irrigation development in the valley has previously relied upon ground water supplies whose source lies in the high mountains to the west and northwest(3).* The lands irrigated with pumped waters are not concentrated in one large body, but are scattered throughout the entire valley. Drainage has not been an important problem in the valley in the past, partly because of the effect of heavy pumping on artesian pressures. There is evidence, however, that with widespread use of Colorado River water and with possibly some decrease in pumping, water tables will rise and may cause serious drainage difficulties in the future. It is the objective of these investigations to obtain such information on the subsurface characteristics of the Coachella Valley as will lead to early detection and delineation of drainage problems, and to establish more rational design procedures for any needed corrective measures.

In order to achieve this objective it is considered necessary to obtain a thorough understanding of the hydrologic and stratigraphic conditions of the valley. This includes information regarding: (a) changes in water table levels with increased use of irrigation water, (b) changes in quality of ground waters with time, as influenced by the use of Colorado River water, which is greatly different in quality from the

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AUTHORS' NOTE: The cooperative investigations referred to in this paper are being conducted by the Coachella Valley County Water District, the Regional Salinity and Rubidoux Laboratories (USDA), the college of agriculture, University of California, and the Bureau of Reclamation (USDI). The investigations were initiated and have been generously supported by the Coachella Valley County Water District. The early organization and instigation of the over-all program was brought about largely through the foresight and efforts of J. H. Snyder, general manager and chief engineer of the District. The participation of the representatives of the U.S. Regional Salinity and Rubidoux Laboratories was under an allotment from the Special Research Fund authorized by Title I of the Bankhead-Jones Act of June 29, 1935, and in cooperation with the agricultural experiment stations of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, and the Territory of Hawaii.

*Numbers in parentheses refer to the appended references.

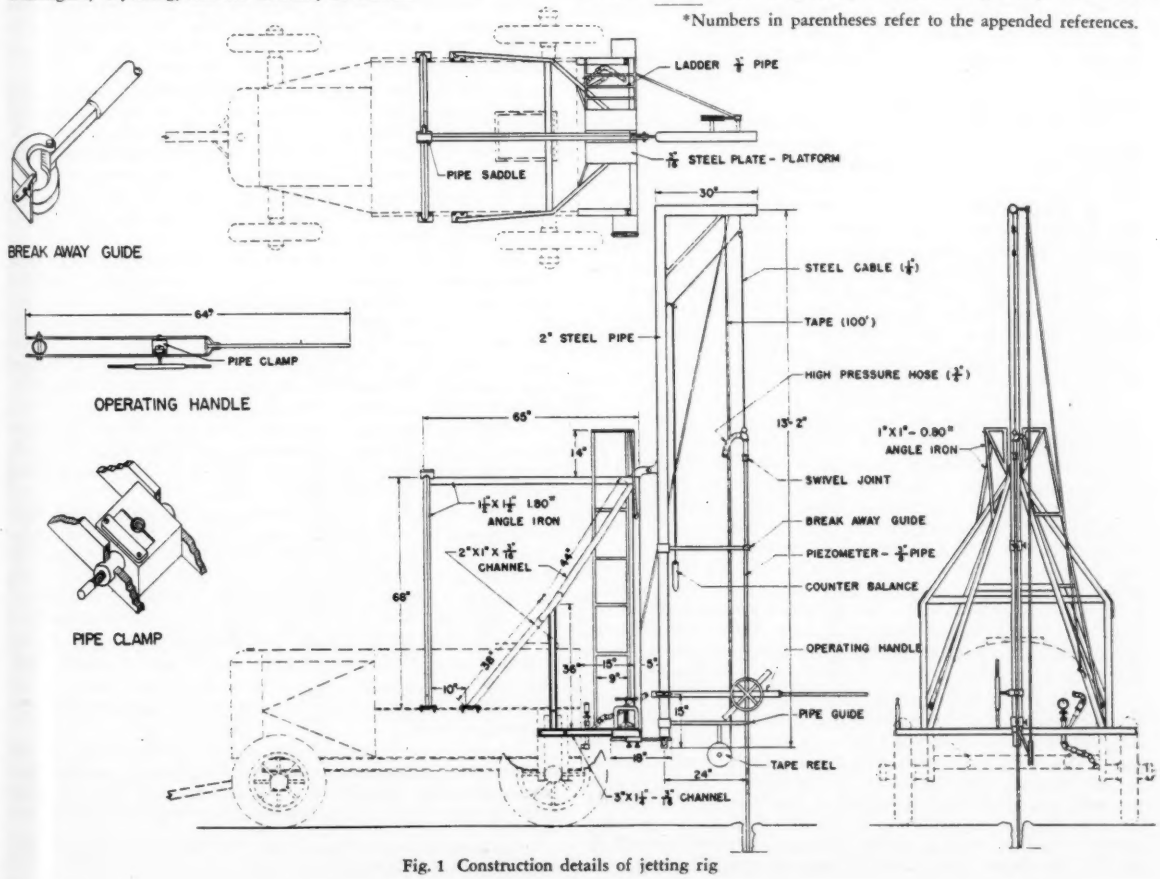

Fig. 1 Construction details of jetting rig

local pumped water, (c) the direction of flow of ground water and extent of natural, surface and subsurface drainage.

The main irrigation canal is lined around the periphery of the valley and irrigation water will be distributed through a concrete pipe system. The contribution to the ground water from conduit seepage will be negligible. In addition, the annual rainfall is low, averaging approximately 3 in, and there are no natural perennial streams in the valley proper. Thus, if artesian pressures are maintained near their present levels, the drainage problem essentially becomes one of providing for removal of excess deep-percolating irrigation water. The extensive use of pumped water for lands, both within and upstream from the lands to receive imported water, is the anticipated means of keeping artesian pressures near their present levels.

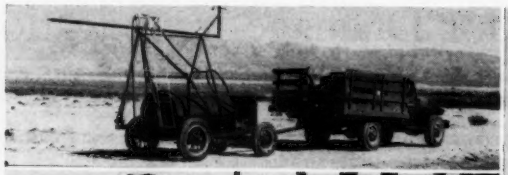

Fig. 2 *(Upper left)* Operating tower folded down to horizontal position to facilitate transport • Fig. 3 *(Right)* Depth of penetration is easily read directly from a measuring tape • Fig. 4 *(Lower left)* Examining suspended sediment in jetting fluid

The major portion of the investigation to date has been the development of suitable techniques and methods for broad-scale study of physical characteristics affecting drainage.

Ground-Water Hydrology. The three principal sources from which the essential data have been obtained are: (a) records of existing wells, (b) drilled and cored observation wells, 2-in diameter, and (c) piezometers, ⅜-in diameter, installed by a jetting technique.

The three sources combined provide logs of subsurface materials to considerable depth, position of water table, its change with time, and changes in quality and direction of flow. Records on irrigation and domestic wells (ranging from 114 to 1880 ft deep) have been kept since 1920 by the Coachella Valley County Water District. In addition, records have been kept on 29 shallow ground-water observation wells (ranging from 11 to 32 ft deep) since 1927. Water level records were summarized and analyzed by Huberty, Pillsbury and Sokoloff(3) for those wells with significant records within the period 1920 to 1947. Also reported are chemical analyses of water from 130 wells in the valley. In the main these records provide background material for the present investigations.

Data from irrigation, industrial and domestic wells are useful in the delineation of artesian areas in the valley. However, unless carefully evaluated such data may be misleading. For instance, the measured static water levels in these wells are an indication of the piezometric pressures in the deep underlying water-bearing strata which usually do not reflect the true water table(4). In addition it is usually quite difficult to obtain detailed stratigraphic data from logs of existing wells. Not all logs of existing wells are available. The majority of those logs which are available do not contain reliable data. Many drillers pay very little attention to the materials encountered in the first 50 to 100 ft in the drilling of deep wells. For drainage investigation this part of the log is the most important. Therefore, logs of existing wells are of little value in this study.

During the early phases of the present study, for investigational purposes only, 42 wells of 6-in diameter were drilled by the hydraulic rotary method. A core-barrel attachment was used. The wells were cased with 2-in inside-diameter asbestos-cement conduit, with the lower 5 to 10 ft perforated and with the well gravel packed to within a few feet of the ground surface. Depths ranged from 37.5 to 105 ft, the average being 80.5 ft. The cost of these wells averaged approximately $1.50 per foot for labor and materials. Samples were obtained with the core-barrel attachment and mechanical analyses were made. Satisfactory samples were obtained with the core-barrel in silts and clays, but samples of sands and gravels in most cases were not secured with this equipment.

In addition to stratigraphic studies, these wells are being used for observation of ground-water levels and for water-quality studies. A specially designed jet pump was developed for obtaining water samples from these 2-in diameter wells. Wells with larger diameter casing would have been more suitable for obtaining representative water samples.

In view of the high cost of drilled wells, emphasis has been placed upon the jetting method of installing small diameter piezometers(6). A rig has been developed to facilitate their installation. The small diameter piezometer is an inexpensive device for measuring piezometric pressures at any desired point below the surface (1, 2, 6, 7, 8, 9). By placing piezometers at various depths and locations, the direction of ground-water flow can be determined.

The installation of batteries of piezometers of varying depths makes possible a detection and separation of free and confined water bodies, perched and semiperched water bodies, and variations in pressure head with depth below ground surface. The permanent nature of piezometers makes possible the observation of water-level and hydraulic-head fluctuations at desired time intervals. Piezometers are also used to observe the effectiveness of tile drainage lines, drainage wells and open drains.

The jetting technique for installing piezometers has given a good qualitative log of subsurface materials. More than 500 piezometers ranging from 10 to 155 ft in depth have been installed in the Coachella Valley to date.

The installation of piezometers by the jetting technique makes use of a high-velocity water jet from the end of a pipe which opens a passage into the soil. The suspended sediment is carried to the surface in the return flow around the outside of the pipe. The return flow together with the "feel" of the pipe serves as a means for logging the materials penetrated(6).

Jetting Rig. The mobile rig developed in these studies provides for easy handling, rapid installation of small diameter pipe (⅜-in), and a log of subsurface materials at a cost of less than one-tenth that of the previously mentioned drilled observation wells.

Construction details of this rig are given in Fig. 1. The rig consists of an operating tower and supporting welded steel frame mounted directly to a commercial-type 300-gal high-pressure spray rig.† The operating tower is constructed so that

†The spray rig used in these studies is a John Bean portable sprayer, model No. 4110, 10 gpm at 600 psi.

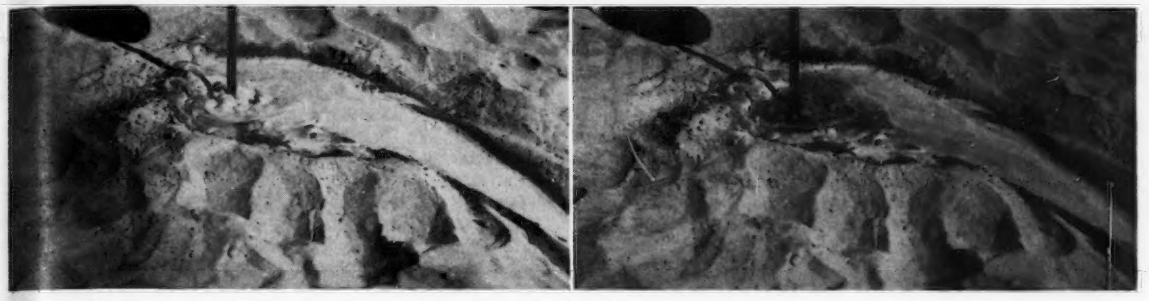

Fig. 5 *(Left)* Light-colored effluent from a medium sand • Fig. 6 *(Right)* A darker colored effluent is produced as piezometer penetrates silty clay

it can be folded down from a vertical to a horizontal position for travel as shown in Fig. 2. The tower in the operating position is plumbed in one direction by leveling the axle of the spray rig, and in the other by movement of the lower end of the tower fore and aft by means of a slide connection. Attached to the lower part of the tower is an operator's handle for working the pipe up and down. It is equipped with a quick-release vise clamp for grasping the pipe. The depth of penetration of the piezometer pipe at any time is read directly on a measuring tape extending parallel to the pipe as shown in Fig. 3. The tape is looped over a pulley at the top of the tower and controlled by two reels at the bottom. Two adjustable guides, one of which can be swung out of the way as the pipe descends, are provided on the tower for guiding the piezometer. A ¾-in high-pressure hose from the spray rig pump supplies fluid to the top of the piezometer pipe through a swivel connection. The swivel connection allows rotation of the upper length of pipe during coupling of additional pipe lengths without twisting the hose.

The rig is towed by a four-wheel-drive truck equipped with power winch. The truck is equipped with a water tank of 300-gal capacity in addition to tools, pipe, and other items required for drilling purposes.

The jetting rig is operated by two men. One man operates the control handle and logs the materials penetrated. The other operates the water pump, controls the water supply, takes notes and has other miscellaneous duties. Sections of pipe approximately 10½ ft in length are convenient for transporting and handling. They are joined by ordinary couplings as each successive length is jetted into the ground.

Jetting Technique. In addition to providing a means for ground-water observation, the piezometers, installed by the

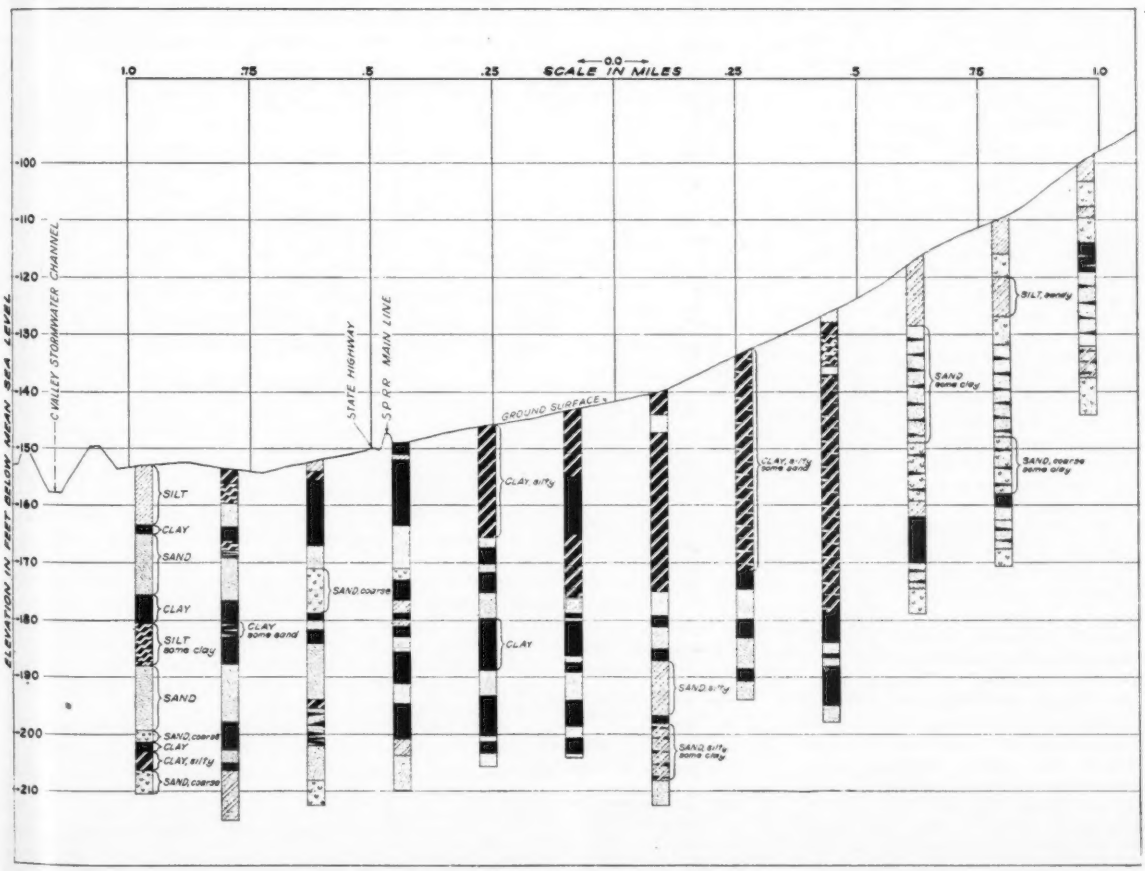

Fig. 7 A typical profile of logs obtained by jetting rig in Coachella Valley, Calif.

technique now used in the Coachella Valley, have provided good qualitative logs of the subsurface materials. Depths of strata changes to within ±0.1 ft are obtained. An estimate of the texture and consolidation of the material is made from (a) the feel of the pipe on the downward motion, (b) the rate of downward progress, (c) examination of sediments carried by the effluent, and (d) observation of color changes that occur in the return flow around the outside of the pipe. The feel might be characterized as varying from smooth to gritty. The rate of penetration is most rapid in silts and fine-grained sands, slowest in clay, and is irregularly impeded by gravel.

Jetting with clear water gave satisfactory progress through clays, silts, and fine sands, but not through highly permeable materials such as coarse sand and gravels. The jetting stream would be "lost" to these permeable materials, and the pipe would become lodged. Ordinarily return flow tends to keep the materials immediately adjacent to the pipe in a state of suspension and the pipe is surrounded by a liquid which offers little frictional resistance. However, when the return flow is lost, the sands settle around the pipe and the skin friction becomes so great that the pipe cannot be moved up or down by the operating lever. This difficulty has been successfully overcome in the Coachella Valley by the addition of a commercial preparation, in powdered form, to the jetting water. It is a gel-forming clay containing about 98 per cent colloidal material. When mixed with water, it forms a thin milky mixture, termed a driller's mud, and has several characteristics which make it ideally suited for jetting piezometers. Being a colloidal mixture with essentially no abrasive materials, it can be safely used without damage to the high-pressure pumping system. In the jetting process an impervious film is deposited on the walls of the hole, preventing excessive losses of water to the soil and the permeable aquifers. Loose gravelly deposits are temporarily consolidated, thus checking their tendency to cave or slough into the hole and in this way the downward movement of the pipe is facilitated.

The viscosity and density of the jetting fluid is increased by use of the drilling-mud which makes it a better carrier for bringing suspended sediment to the surface for examination (Fig. 4). At the time this picture was taken the piezometer was penetrating a medium sand. In addition, change in color of the effluent when silts and clays are penetrated is an important characteristic in the logging of subsoil materials. The drilling-mud mixture is white, making an excellent background for noting color changes due to silts and clays which are generally darker in color than the coarser textured materials. Fig. 5 shows the effluent from a medium sand, and Fig. 6 taken later shows the change in color that occurred within a few seconds after the piezometer penetrated a silty clay.

It has been determined that under average drilling conditions in the Coachella Valley best results are obtained by mixing 30 lb of the commercial preparation to 300 gal of water. The powder must be added to the water slowly and in small amounts to avoid "curdling". Constant agitation during the mixing and jetting is necessary. Where coarse materials are encountered at a depth approaching 100 ft, it is usually necessary to increase the amount of commercial mud to a mixture of about 40 to 45 lb to 300 gal of water. It was also found by adding approximately 3 lb of lime to each 300 gal of water the resulting mixture was much more effective.

Jetting speeds average approximately 50 ft per hr. Fluid requirements vary with depth of well and the type of materials encountered. In general, the coarser the materials, the greater the amount of fluid required. Under average conditions in the Coachella Valley the installation of a 75 ft piezometer requires about 200 gal. One piezometer jetted to a depth of 155 ft through coarse materials required approximately 600 gal.

Observation Network. A grid system based on public land survey is used for designation and location of observation wells in this study. The 42 drilled wells are located on a 2-mile grid over the valley floor. The grid pattern has been filled in with piezometers on a one-mile spacing, and a half-mile spacing of piezometers is presently about 60 per cent complete. In areas of localized high water table, the number of piezometers installed is increased for detail study. The usual piezometer installation consists of one pipe at each location to measure the water-table level. The depth of pipe is determined by the lowest level to which the water table is expected to reach. At locations where stratigraphic conditions indicate the possibility of vertical hydraulic gradients, two or more piezometers, each to a different depth, are installed in close proximity. Water-level measurements were begun on the forty-two 2-in diameter observation wells in July, 1948. All wells and piezometers then installed were read at monthly intervals, but it was found that a few were representative of an area. This resulted in the reading of only the key wells and piezometers on a monthly basis, and the remainder at a less frequent interval. If unusual changes are observed in a key well, then all wells and piezometers in that area are read on the monthly basis until the reason for the change has been determined.

One of the principal uses for piezometers in drainage investigations is for locating and mapping the water table. A water-table contour map serves many useful purposes. It clearly shows the direction of ground-water movement and to some

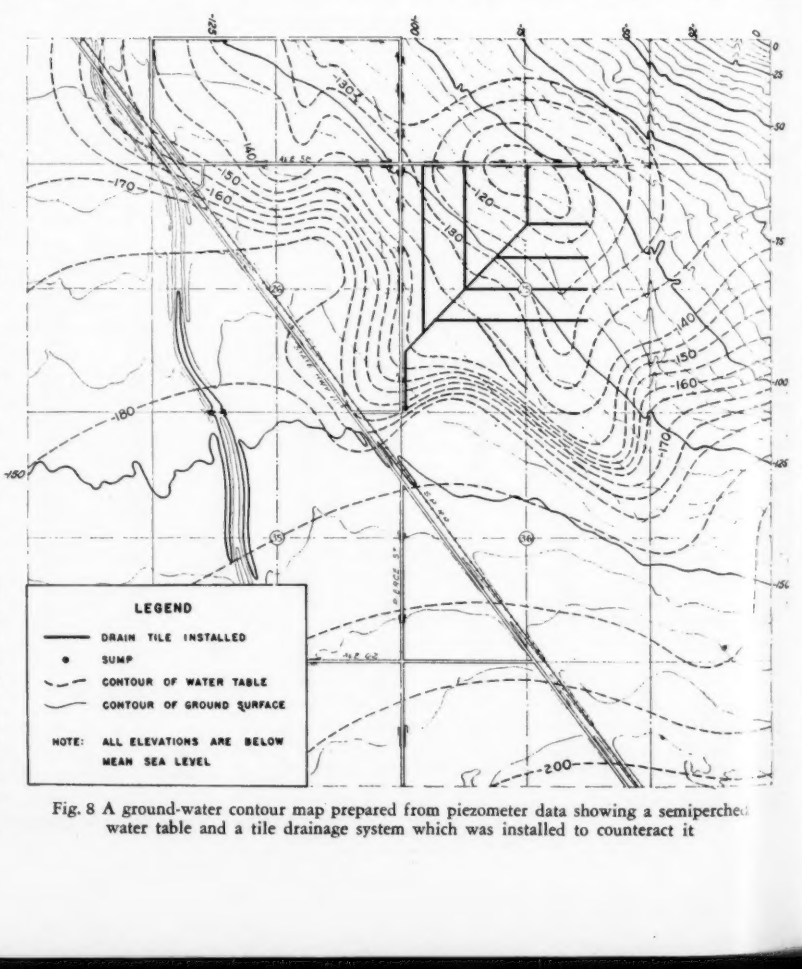

Fig. 8 A ground-water contour map prepared from piezometer data showing a semiperched water table and a tile drainage system which was installed to counteract it

extent indicates the hydrologic character of the aquifer material. By comparison with a topographic map of the area, the depth to water at any point can be determined.

Water-table contour and depth-to-water maps have been prepared in this study and will serve as a useful reference with which to compare future water-table elevations. The depth to water table as of June 1, 1949, prior to entry of Colorado River Water into the valley (except for small quantities), ranged from 125 ft at the upper end of the irrigated district a few miles west of Indio, to less than 5 ft near the Salton Sea. Over the greater portion of the area on this date, the depth to water was greater than 25 ft.

By a study of the rate of change of the water table and the application of irrigation water, a comparatively accurate determination of the natural drainage can be made. Such a determintion is useful in predicting the amount of water that may eventually have to be removed by artificial drainage. The shape of the water table will also be useful in determining the horizontal directions of underground flow. By a comparison of the initial water-table contours and those made later when significant changes have occurred, it may be possible to determine which irrigated lands contribute most heavily to the ground water.

Quality of waters from about one-fifth of the irrigation and domestic wells in the valley were determined in previous hydrologic studies(3). Because of the great difference in quality of the ground water in the valley from that of the Colorado River, it is expected that significant changes in quality of shallow ground waters will occur.

With this as a basis, studies are being made of ground water quality and changes with time. The grid of 42 drilled wells serves for obtaining ground-water samples. Shallow domestic wells are not used because of inadequate control for investigational purposes.

The first samples taken from some of the 42 drilled wells had a high pH and were not representative of ground water obtained from nearby auger holes. Laboratory tests indicated that the casing was the major source of contamination. It is also probable that some of the contamination was due to the lime used in the drilling fluid. It was found by field and laboratory tests that a representative ground-water sample could be obtained by pumping each well for a period of 6 hr at a minimum rate of 2 gpm. At the time of the initial sampling only 13 of the 42 wells could be pumped by suction. A hydraulic jet-type pump was developed which made it possible to obtain samples from 10 additional wells. A fairly complete coverage of the valley is given by these 23 wells. The remaining 19 wells are either dry or yield insufficient water to permit obtaining a representative sample. Future sampling will be done at sufficiently frequent intervals to follow major quality changes.

Logging of Materials. The principal value of logs of subsurface materials in a drainage investigation is their use in estimating permeability of the materials encountered. Texture is the characteristic most generally used in such estimates, and the one used in these studies. The principal textural classifications used both for the hydraulic-rotary and jetting methods are gravel, coarse sand, medium sand, fine sand, silt, and clay.

These materials occur predominantly in alternating discontinuous beds throughout the valley. They also occur both intermixed and locally interbedded with thin lenses. In general, the sands and gravels encountered have been comparatively clean with a light greyish cast. Finer sands and silts, material apparently redistributed by wind, have a much darker micaceous cast and appear almost black in the jetting effluent. Clays vary in color from brown to grey. They are often hard and dense, but where saturated are easily penetrated. Clay balls are frequently found mixed in with silts and sands.

Piezometers were installed adjacent to some of the 42 drilled wells for log comparison. Mechanical analyses were made of the hydraulic rotary core-barrel samples which were fitted in with the driller's logs. Since depths of material changes can be determined to within ± 0.1 ft with the jetting technique, this method makes possible the detection of thin strata. The drilled-well logs were deficient in this respect. The core barrel was selective, usually rejecting sands and gravels and picking up silts and clays. Because of this the depths at which a material was encountered was uncertain, and there was a tendency to show a large percentage of silts and clays in the log.

Log comparisons are complicated by the unusual geologic conditions of the Valley. The subsurface materials are extremely stratified and the strata are not continuous. They may vary considerably in thickness or disappear entirely within a short distance. Although the major tendency is for the strata to be parallel to the ground surface, this is not always the case. A typical profile of logs obtained by the jetting rig is shown in Fig. 7.

An index of permeability of the various strata would be more useful in a drainage survey than a log of textural classification. Some work has been done with the jetting technique in an attempt to log the materials, according to their permeability rather than their textural classification alone. It is probable that with further refinement of the jetting equipment and techniques this can be accomplished.

Application of Techniques. Only after complete hydrologic and stratigraphic data have been collected and evaluated can an efficient economic drainage system be designed. In the Coachella Valley it is likely that adequate drainage control will result only from application of preventive measures and from the use of a combination of conventional drainage methods in an over-all drainage system. Control of artesian pressures by continued or expanded pumping for irrigation and efficient use of irrigation water are of major consideration in controlling the quantities of excess waters to be removed by drainage.

Subsurface logs indicate that drainage by pumping may be possible in some areas in the valley, whereas drainage by tile may be feasible in others. Open drains may prove adequate in some instances, but in general are objectionable. Continued experimentation and intensive investigation will form the basis for design of the valley drainage system.

The following is an example of the application of the techniques of these investigations to a specific problem: In the spring of 1949, the data from the observation network indicated that a drainage problem was arising in an area comprising 700 acres and located a few miles southeast of Thermal. Since 1948 the irrigation supply in this area has been supplemented with Colorado River water. This area had previously been irrigated with pumped water and since 1932 that supply has been inadequate. In 1932, in connection with another investigation(5), the water table was observed 7 to 9 ft from the soil surface. With the more liberal use of irrigation water since 1948, the water table has risen above the previous level. Seventy-nine piezometers and 80 auger holes were installed over an area of approximately 1600 acres to study the hydrologic conditions. A ground water contour map prepared from piezometer data and presented in Fig. 8, shows a ground-water mound under the irrigated area. The depth to the water table over the 1600 acres varied from less than 3 to 35 ft. Logs of subsurface materials and piezometer data indicated that the water table was semiperched. In general the logs showed that the first 10 ft of materials consisted of silt, clay and fine sands, intermingled with layers and lenses of medium sand. Below the upper 10 ft, to a depth of 35 ft or more, the materials consisted largely of fine-textured silts and clays.

In view of these hydrologic conditions and the nature of the plantings in the affected area, tile drainage appeared to be the most feasible method. A tile system, a layout of which is shown in Fig. 8, was designed and recommended and has been installed by the property owner. Tests on the efficiency of the installation have been initiated.

CONCLUSIONS

This investigation is unique since an intensive study was initiated before any great drainage problem existed in the area, and basic data were obtained prior to the importation of water. In this respect, it is probably the first investigation of its type in the history of irrigation development in the United

States. Usually investigations are made after crops have been damaged and lands made saline because of high water tables. The techniques developed for installing piezometers are fast, inexpensive and effective in obtaining hydrologic data, and are an improvement over past methods.

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Automatic Hay Baler

(Continued from page 558)

were familiar with this size bale and that was the size they wanted to handle.

About 8 or 10 years ago, a smaller size baler was introduced into the California-Arizona territory. There was great resistance to these balers from the farmers because they claimed the truck drivers and hay buyers would not handle the smaller size bales such as 14 x 18-in or 16 x 18-in size bales which were about 36 to 40 in long, weighing about 100 lb more or less. The truck drivers claimed they could not get as much tonnage in a truck or in a car for shipment. The biggest objection from the hay buyers was the fact that the truckers would not handle the bales. In other areas of the United States, the farmers and truckers preferred to use a 14 x 18-in or 16 x 18-in size bale rather than the 18 x 22 because they did not know how to handle or load the larger bales.

This past season I was in California and heard a report from one of the truck drivers who had a load of 16 x 18-in bales. He stated that he could actually put more tons of hay on his truck since he has learned how to load the small bales than he could when he was hauling the larger size bales. He was very much pleased with the size of the bales because they were much easier to handle. It seems as though the trend for bale size has been toward a smaller size bale, making it easier for one individual to handle them without help.

There has always been quite a controversy as to what type of material should be used for tying bales. Some claim that twine is best and some claim wire. At the present time, at least, there seems to be a demand for both types of material. Both have advantages and disadvantages. A farmer who is going to feed his own hay seems to prefer twine since it is much easier to feed the hay and dispose of the twine. The farmer who is going to sell his hay where bales must be handled several times, such as loading onto trucks or into freight cars, prefers wire because it usually ties the bale more securely. What the trend will be in the future I do not know, but I believe there will be quite a demand for both types of machines for a considerable time.

In reviewing the history of the development of automatic balers, it seems the demand for these machines has come from the farmer because it is a machine with which he can save a lot of labor and also prepare his hay so it can be transported to market. The manufacturers of farm machinery have taken hold of the opportunity of developing machines to meet the demands and needs of farmers and have put quality balers on the market. A few of the improvements and developments which have been put on balers have come from ideas that the farmers themselves have worked out. A great number have also come from the engineers who are working in the engineering divisions of the various manufacturing companies interested in agricultural implements.

Many times it seems to the farmer that the machines he wants are not readily available to meet the conditions that he wants them to meet, so he takes it upon himself to build one of his own. It usually works very well under his particular conditions. And he doesn't have to worry about conditions elsewhere in the country. Machines developed by the manufacturers of farm machinery have to be developed to work well in all sections of the country, so a longer period of time is required for testing and developing. If the farmers and manufacturers work together hand-in-hand, as they have done in the past, I am certain that many more improvements will be brought forth in the future to eventually make it still easier for the farmer to handle his hay crop.

Fertilizer Placement Machine

(Continued from page 556)

flexible tube to the runner. The three-compartment hoppers complete their movement into the brushes and thus deliver all of the fertilizer to the collector spout when the pinions reach the end of the racks.

It is necessary to pull the fertilizer trays back to the forward position by hand for refilling before starting each new test-plot row. Refilling is accomplished by leveling off the desired amount of nitrogen, phosphate or potash in each compartment of the three-compartment hoppers. If the fertilizer is in a dry granular state, the compartments can be filled to a maximum depth of about 2 in and the rotating brushes will still insure uniform distribution. The machine will function without brushes, but if used without them the depth of fertilizer in the hoppers should not exceed ½ to ¾ in.

The maximum rate of application for any one type of fertilizer is about 5500 lb per acre. This rate could be accomplished by filling all three compartments of each hopper with the same fertilizer to a depth of about 2 in and by using the sprocket combination which will cause delivery of all of the fertilizer on a 44.9-ft row. Assuming the density of the fertilizer to be 60 lb per cu ft and row spacing to be 42 in, a maximum application at the rate of about 5500 lb per acre could be accurately distributed. In contrast with this amount, very light applications can also be accurately distributed. For any given length of test-plot row the rate of application is varied simply by changing the amount of fertilizer which is put into the hoppers.

The Kansas State fertilizer placement machine was used extensively during the spring of 1950 in making test-plot applications. The only difficulty encountered was that of high velocity wind whipping the fertilizer out of the three compartment hoppers. A metal shield fastened to the framework, which supports the brush shaft, effectively remedied this difficulty. The shields were not fastened to the hoppers. They were hinged to the brush support framework and allowed the hoppers to pass underneath.

The agronomists at Kansas State College were enthusiastic about the performance of the Kansas State machine. They have extensive plans for using it in future fertilizer research studies.

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Economic Studies of Farm Electrification

By Joe F. Davis

FOR the last two and one-half years the Bureau of Agricultural Economics (USDA) has been conducting economic investigations under the work project title "Factors Affecting Electric Power Consumption on Farms". Thus far the work has been directed toward two principal objectives. The first is to establish criteria which will be useful in estimating the probable future use of electricity on farms of various types and sizes and in different situations. This information will provide a basis by which suppliers may improve their services in rural areas. The second is to appraise the possibilities of electricity in increasing the efficiency and in reducing costs of agricultural production.

These are new lines of work, made possible by funds appropriated under the Research and Marketing Act of 1946. Valuable contributions have been made by other interested groups. All of the work is carried out with the formal cooperation and assistance of state agricultural experiment stations. Various federal agencies have given advice and assistance. Suppliers of electricity in the study areas have freely contributed consumption and cost data for the farms studied. In fact, everyone contacted has been most cooperative and helpful.

Six surveys have been completed—in the states of Georgia, Iowa, Kansas, Tennessee, and Washington. Reports for three of these are now in press. They are for the surveys in northwestern Washington, eastern Iowa and the upper Piedmont of Georgia. Analyses of the data from the other three are progressing rapidly.

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at Washington, D. C., June, 1950, as a contribution of the Rural Electric Division.

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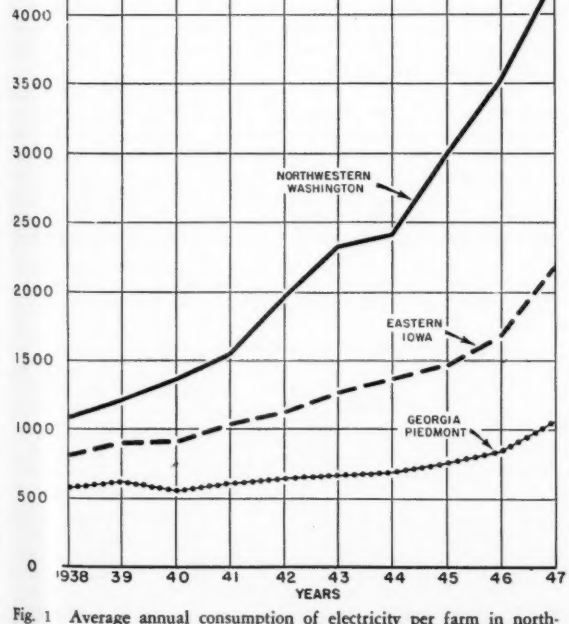

Fig. 1 Average annual consumption of electricity per farm in northwestern Washington, eastern Iowa, and upper Piedmont of Georgia, 1938-47

In these surveys, records were taken from 300 to 600 farmers who had used central station electric service for at least one year—some have received the service for 30 years or more. The farms were selected at random and were intended to be representative of all electrified farms in the study areas. Some were served by power companies, some by municipalities and some by rural electric cooperatives. The number of electrified farms per study area ranged from 2,000 to 39,000. Trained enumerators were used in all surveys.

Information was obtained concerning the farm size, farm organization, family income and the uses made of electricity on the farm. The record of kilowatt-hours used annually and its cost to the farm was obtained for a 10-year period or for such portion of that time as the farm was electrified and the data were available. This made it possible to relate the uses made of electricity to various physical and economic characteristics of the farms.

Preliminary results emerging from these studies indicate that in a given area the use of electricity is principally a function of three major factors—time, income, and size of specific farm enterprises, particularly dairy and poultry enterprises. Time is necessary for the farmer to become acquainted with the potentialities of electricity on the farm. Time is also necessary for him to acquire and install the necessary equipment. An adequate income is necessary for him to make the desired purchases. And he must have a sizable farm business to have a need for much electrical equipment in his farming operations.

Time As An Influence. As to the time factor, consumption and cost data for the period 1938 to 1947 inclusive were obtained in the Georgia, Iowa and northwestern Washington surveys. In each of these areas farms continued to increase their use of electricity even after 30 or more years of service (Fig. 1). Average consumption per farm in the Washington area was almost 4 times as great in 1947 as it was in 1938. In the Iowa area, the average had increased 2½ times and in the Georgia area it had almost doubled. Practically all of the farms in the Washington survey were electrified before 1930; less than 10 per cent of the Iowa sample farms had been electrified that long, while only 2 per cent of the farms in the Georgia sample had received service before 1930.

Average consumption per farm in 1947 in the Washington area was almost 4,300 kw-hr. In the Iowa area, the average was almost 2,200 kw-hr, and in Georgia, 1,050. These differences between areas in the levels of consumption probably were due in part to the time factor, but differences in the need for electricity in farming operations were also an influence.

It has long been recognized that, as a rule, newly electrified farms have less electrical equipment and use less electricity than do similar farms that have had the service for some time. These differences are easily discernible in the Georgia and Iowa data. In the Georgia area, farms that were connected to a power line before 1940 used an average of 1380 kw-hr in 1947, while the farms connected after 1943 used a little more than half as much (Fig. 2). In the Iowa area, farms that were connected to a power line before 1943 averaged 2,550 kw-hr in 1947, or 85 per cent more than those that received the service in 1943 and later years (Fig. 3). These differences extended back through the decade of record but were greater in later than in earlier years.

The increased use of electricity during the decade came about largely because of the installation and use of new electrical equipment rather than an increase in lighting. In the Iowa area for example, the average amount of energy used for lighting was about the same in 1947 as it was in 1938, but the amount used for other purposes increased about 350 per cent. Consequently, the amount of electric energy to operate equipment increased from about half of the total in 1938 to more than 80 per cent in 1947. It is interesting to note what equipment was added.

Records from the Iowa area indicate that the proportion of

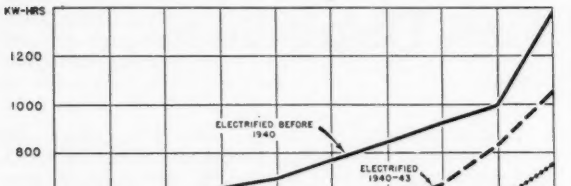

Fig. 2 Average annual consumption of electricity by period of electrification, upper Piedmont of Georgia, 1938-47

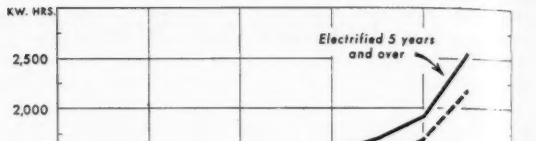

Fig. 3 Average annual kilowatt-hours consumption by period of electrification, eastern Iowa, 1938-47

electrified farms with electric ranges increased from about 4 per cent in 1938 to 27 per cent in April, 1948. The proportion with electric refrigerators increased from 30 to 80 per cent. Food freezers were not used by any of the farms in 1938 but by April, 1948, 10 per cent of the farms had one or more.

Water systems are greatly desired by most farm families and on farm after farm, electricity from central station sources has made it possible for this desire to be realized. Approximately one-fourth of the Iowa sample farms had a pressure water system in 1938 and by 1948 about one-half of them had one. To be most useful, the water system requires an automatic water heating device. In 1948 about half of the Iowa sample farms that had water systems used electric water heaters, as compared to about a sixth of the farms a decade earlier.

Milking machines, electrically driven shop tools and other equipment used in the farming operations were also bought by many farms in the decade.

These studies indicate that the radio and the flatiron are the most universally adopted pieces of equipment. Almost all electrified farms had at least one radio and one iron but many had two or more. Electric clocks, toasters, vacuum cleaners and other small appliances also were found in large numbers. But in so far as total usage of electricity is concerned, the kitchen range, the water heater, and the refrigerator are the most important kinds of equipment. And for these there was considerable variation among the study areas.

Eighty per cent of the farms in the Iowa and Washington areas had electric refrigerators as compared to 65 per cent in the Georgia area. Electric water heaters were found on about one-third of the Washington farms, one-fourth of the Iowa farms and one-tenth of the Georgia farms. Electric ranges had about the same distribution but were a little more numerous than water heaters in Georgia. Hot plates, however, outnumbered the electric ranges two to one in both the Georgia and Washington areas and were considerably more numerous than ranges in the Iowa area.

One interesting difference among the areas was in the use of washing machines driven by electricity. These were used on more than 90 per cent of the farms in both the Iowa and Washington areas but on only 33 per cent of the farms in the Georgia study.

The most highly valued single use of electricity as reported by many of the farmers was for lighting. In second place was power for pumping water. Approximately 35 per cent of the farms in Iowa used electricity on a pump jack for pumping water. This pumping was in addition to the pumping for pressure or gravity-type water systems previously mentioned.

For use in the farming operations, electricity was most widely adopted in the dairy and poultry enterprises. Shop tools were being installed rapidly, especially in Iowa. Other occasional uses were for grain elevating, seed cleaning, corn shelling and feed grinding.

Thus the bulk of the electricity used on the farms was for household operations rather than for farming. In the Georgia area about 90 per cent of all the electricity used on the farms was for the farm households. In the Iowa area about 80 per cent was so used and in the Washington area almost 65 per cent. A complete list of the equipment used on the farms is given in Table 1.

The Income Factor. Income has been mentioned as one of the major influences that may affect the amount of electricity used on a farm. This influence was clearly indicated in these three surveys. In all three areas practically all of the farms, regardless of the income level, had a radio and a flatiron. But the farms with high incomes had more of all other kinds of equipment than did farms with low incomes of similar types. Consequently the farms with high incomes used more electricity than did those with low incomes.

Among the Iowa farms that had been electrified for 5 years or more in 1947, an increase of $1,000 total income was associated with an average increase of about 118 kw-hr used during the year. In the Georgia area, an increase of $1,000 total income was associated with an average increase of 190 kw-hr among farms that had received the service for 3 years or more. It is significant that the general level of incomes in the Iowa area was substantially higher than in the Georgia area.

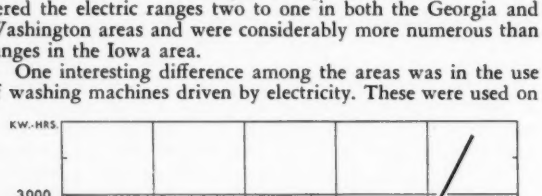

Fig. 4 Average annual kilowatt-hours consumption by income groups, eastern Iowa, 1938-47, on farms electrified 5 years or more

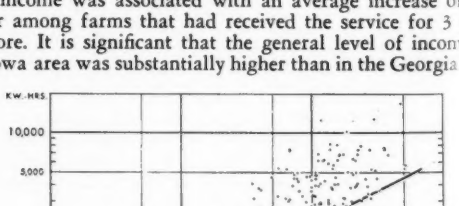

Fig. 5 Correlation between kilowatt-hours consumption and total income of individual farms in eastern Iowa, 1947, on farms electrified 5 years or more

TABLE 1. PERCENTAGE OF FARMS USING SPECIFIED ELECTRICAL EQUIPMENT AND PIECES OF EQUIPMENT PER 100 FARMS, STUDY AREAS OF THE UPPER PIEDMONT OF GEORGIA, NORTHWESTERN WASHINGTON AND EASTERN IOWA, 1948

	Farms reporting equipment			Equipment per 100 farms		
Item	Georgia area	Iowa area	Washington area	Georgia area	Iowa area	Washington area
Farms represented	557	461	481	557	461	481
Household equipment	per cent	per cent	per cent	number	number	number
Refrigerator	65.2	80.3	80.8	68.4	85.0	83.5
Range	16.2	27.1	33.6	16.7	28.2	35.4
Water heater	10.6	23.2	34.0	11.1	24.5	35.3
Freezer cabinet	1.3	9.5	2.6	1.3	10.2	2.8
Washing machine	32.9	91.3	94.7	33.8	98.9	96.4
Radio	97.7	97.4	97.9	126.0	146.4	155.2
Iron	98.6	98.3	98.1	112.2	108.0	102.9
Clock	15.8	67.0	70.9	18.1	95.7	97.2
Toaster	10.8	78.1	74.8	11.5	82.9	77.0
Vacuum cleaner	7.7	67.0	65.4	7.9	72.0	67.1
Household fan	21.0	48.4	*	23.3	60.1	*
Food mixer	3.1	36.7	43.7	3.1	37.5	44.9
Heat pad	6.3	31.9	40.3	6.8	34.3	41.7
Hot plate	28.2	37.1	66.2	28.7	39.0	71.4
Waffle iron	5.6	37.3	73.6	5.9	39.0	76.3
Space heater	2.9	19.5	18.6	2.9	20.4	22.4
Sewing machine	4.1	13.7	19.0	4.1	13.7	19.0
Percolator	8.4	9.8	43.7	9.0	10.6	41.4
Roaster	2.0	6.1	5.0	2.0	6.1	5.0
Ironer	0.2	4.8	8.8	0.2	5.0	8.8
Coal stoker	0.5	6.1	*	0.7	6.1	*
Oil furnace	—	6.1	9.5	—	6.3	9.5
Hot-air fan	—	16.5	20.7	—	16.7	21.8
Hot-water pump	—	1.7	2.3	—	1.7	2.3
Air-conditioning unit	—	0.9	*	—	0.9	*
Blanket	1.6	2.0	4.4	1.8	2.4	5.0
Broiler	0.5	2.4	3.6	0.5	2.4	4.2
Ventilating fan	1.1	1.1	*	1.1	1.1	*
Ice-cream freezer	0.2	1.1	*	0.2	1.1	*
Churn	47.2	*	*	48.3	*	*
Dish washer	—	0.2	1.4	—	0.2	1.4
Water systems						
Pressure system	44.7†	48.2	70.6	45.4	59.0	74.6
Gravity system	—	10.0	—	—	11.1	—
Pump jack	—	35.6	2.1	—	38.2	‡
City water	—	—	46.7	—	—	—
Farm shop						
Air compressor	0.2	13.7	3.9	0.2	13.7	‡
Drill press	0.2	13.7	8.7	0.2	13.9	‡
Portable drill	2.5	9.3	2.7	2.7	9.5	‡
Tool grinder	1.4	37.1	30.6	1.4	39.0	‡
Power saw	1.8	10.0	14.1	2.0	11.1	‡
Welder	0.4	8.5	2.6	0.4	8.7	3.2
Battery charger	—	4.8	2.0	—	5.0	‡
Lathe	0.2	2.4	1.2	0.2	2.4	‡
Forge	0.2	0.9	1.8	0.2	0.9	‡
Concrete mixer	—	3.9	8.0	—	3.9	‡
Soldering iron	1.4	22.8	8.4	1.6	24.5	‡
Dairy equipment						
Cream separator	—	59.9	—	—	60.1	—
Milking machine	1.6	20.6	52.4	2.9	21.3	54.8
Water heater	1.4	4.6	34.0	1.6	4.6	35.3
Ventilator fan	—	1.7	—	—	2.0	—
Churn	0.9	1.5	—	0.9	1.5	—
Milk cooler	2.3	0.4	1.6	2.3	0.4	1.7
Livestock equipment						
Pig brooder	—	13.7	26.1	—	70.3	37.3
Tank heater	—	10.4	*	—	13.9	*
Fence controller	1.3	8.5	59.4	1.3	9.1	‡
Stock clipper	0.5	1.7	*	0.5	1.7	*
Poultry equipment						
Brooder hover	4.7	39.9	‡	7.2	42.7	25.5
Brooder battery	0.2	0.4	‡	0.2	0.4	2.3
Water warmer	—	18.0	*	—	24.5	*
Other farm equipment						
Grain elevator	—	9.5	0.4	—	10.0	‡
Corn sheller	—	6.9	*	—	6.9	*
Seed cleaner	—	6.9	0.3	—	6.9	‡
Feed grinder	—	1.1	4.9	—	1.1	‡
Grain drier	—	0.2	*	—	0.2	*
Hay hoist	—	0.2	30.4	—	0.2	‡

* Not recorded. † Includes all water systems. ‡ Information not available.

This does not mean that higher income was the sole cause for the greater consumption. Other conditions that affected the amount of electricity used were combined with income to result in the greater use. The high-income farms were larger business enterprises so they had more need for electrical equipment in the farming operations. They had more dwellings per farm so had more need for household equipment. As a rule their buildings were larger and so they had more need for lighting and other services.

On dairy farms in the Washington area, an increase of $1,000 total income in 1947 was associated with an increase of about 450 kw-hr used that year. Apparently this greater use came about to a large extent because farms with a number of cows had more need for electrical equipment in the dairy than did those with few cows.

The tendency for farms with high incomes to use more electricity than farms with low incomes seemed to be accentuated during the decade of record rather than diminished. In the Iowa area, for example, farms in the medium and high income groups increased their consumption at the average rate of about 12 per cent per year. But the low-income farms increased their consumption at the rate of about 7 per cent per year (Fig. 4).

These data do not imply that there was a strong tendency for individual farms at any income level to adhere closely to the average for the group. Actually the reverse was true; at all income levels there was a wide variation in the amounts of electricity used by individual farms. The farms that had been electrified for 5 years or more in the Iowa study may be used for illustration. In the $25,000 and over total income group, the range in consumption in 1947 was from 500 to more than 16,000 kw-hr. In the group with less than $2,500 total income the range was from 200 to 2,600 kw-hr (Fig. 5).

There is no obvious indication of the reasons why some farms used 8 or 10 times as much electricity as some other farms that were similar as to type and income. Clearly there are many considerations that influence farmers' decisions along these lines. Some farmers, for example, have delayed the installation of a water system until a new home is built. Some

continue to use a coal-burning range because there is no central heating in the home. Some will continue to use old equipment until it is worn out and must be replaced. Still others cling to traditional methods because established habits are difficult to break.

Sizes of Farm Enterprises. Earlier in this paper it was noted that the sizes of specific farm enterprises, particularly dairy and poultry, were a major influence affecting the amount of electricity used on farms. This has been apparent in all of the work done to date.

Electric brooders for chicks have been generally adopted on farms raising from 100 to 500 or 600 chicks. But for commercial broiler flocks of 1,000 or more chicks, other sources of heat are used almost to the exclusion of electricity. Fear of outages seems to be a deterrent to wider use of electric brooders in these areas.

Special electrical equipment is being installed on some farms where the poultry enterprise is large enough to justify their use. Included in this category are scalders, pickers and devices for grading and sorting eggs. Rooms for handling eggs are usually cool and frequently require space heaters and ventilating fans.

Electrical equipment commonly used in the dairy enterprise includes the milking machine, milk cooler and water heater. All three of these were more commonly used on farms with a large number of cows than on those with only a few. In the Iowa area for example, 9 per cent of the farms that had 4, 5 or 6 milk cows had a milking machine. Above this number of cows the percentage of farms with milking machines increased rapidly to almost 80 per cent of the farms with 15 to 35 cows.

In passing, it may be noted that 60 per cent of the farms in the Iowa sample reported an electric cream separator but not one was reported in the Georgia survey.

Brooding pigs by means of electricity is spreading rapidly in the Iowa area. Here again, the use of this equipment was directly related to the number of spring pigs raised on the farm. The use of these brooders is making it possible for some farmers to push farrowing time ahead by 2 to 4 weeks, thus reaching an earlier market with their hogs.

Prospects for the Next Ten Years. These studies indicate that within another 10 years or so the average consumption per farm in these areas may easily be from 2 to 2½ times what it was in 1947. Farmers desire all kinds of equipment that will reduce production costs or that will make farm life more pleasant. The young people are being trained to handle various kinds of mechanical devices and they readily accept some equipment as necessities rather than luxuries.

The increased use of electricity is expected to come about because of the installation of many kinds of equipment both for the household and for farm operations. However, a large part of the electricity probably will be used to operate a few kinds of household equipment. In the Iowa area five kinds of equipment—refrigerators, ranges, water heaters, freezer cabinets, and airconditioning units—may take about half of all the electricity used on those farms. Farm production uses may require about one-fourth of the total.

These estimates are based on four assumptions. First, that distribution lines will be extended until the service is available to virtually all farms in these areas. Second, that the power available to the farms will be dependable and adequate for their needs. Third, that farm incomes will remain at a reasonably high level. Fourth, that there will be no revolutionary technological developments that will affect equipment using either electricity or competing kinds of energy. These are assumptions; they are not predictions.

The actual achievements of the next decade may be influenced to a marked degree by the work of the engineers. For example, there is the problem of outages. Many of the farmers interviewed in these surveys have talked about the times when the power went off and what they had to do to cook meals or to pump water or to keep baby chicks from chilling. Outages have militated against the greater use of electricity on farms. And as farmers depend more and more on electricity, outages cause more and more inconvenience and loss. To reduce the frequency or duration of outages surely would encourage farmers to use more electric equipment.

In the equipment field new uses for electricity are being found and equipment now in use is being perfected. Perhaps there will be some revolutionary developments in the next few years that would knock into a cocked hat any prediction that might be made at this time.

More Studies Needed. It is planned that economic studies similar to the ones here described will be continued until one survey has been made in each of the major type-of-farming areas of the country. One was begun last week in north central North Dakota. For the next fiscal year three new ones are contemplated—one in Mississippi, one in Wisconsin, and one in an irrigated area of the southwest. During the year following, surveys may be started in the eastern corn belt, the Northeast and the Middle Atlantic areas.

A pilot study to determine the role of electricity in the general scheme of mechanization was begun in Iowa. This type of study may be expanded to other areas.

Thus far the influence of the rate structures under which electric energy is sold to farmers has not been studied. It is recognized, however, that cost to the farmer does influence to some degree the amount of electricity he uses. A project plan for an investigation of this phase is now being developed. Suggestions for the improvement of this work are solicited.

"Freedom Isn't Free"

(Continued from page 549)

be further strengthened seems the one bright hope for our continued, uninterrupted enjoyment of the advantages of freedom.

Freedom isn't free, but it is better worth its price than any other condition of life yet discovered. It is worth some engineering thought on stabilization of foundations, governing mechanisms, dynamic balancing, and the counteracting of cycling influences, in the mechanics of human relations.

Want a copy of Mr. Macleod's address, of which the foregoing represents a few of the high lights?

Dealer Training

PROGRESS in the technology of agricultural engineering; its application in farm mechanical, structural, and electrical equipment; and the increasing use of such equipment on farms combine to set a fast pace for farm equipment dealers and similar farm service organizations.

It is getting to where a dealer's organization, to be of effective service to farmers, must be a jack of many trades and master of several.

It requires helping farmers make effective use of products with engineering and mechanical refinement equal to that of the airplane; in expanding variety far greater than encountered by the automobile dealer; to justify investment values commonly ranging from $2000 to $20,000 per farm; in applications consistent with the changing recommendations of agricultural science, the agricultural extension services, and leading farmers; all this while keeping equally up to date on sound business procedure and dealer practices.

In many instances, retail dealers are important links between agricultural engineers and farmers. They are agencies through which agricultural engineering work, embodied in improved products, becomes actually and economically available to farmers. How well these dealers are able to do their job will influence the rate of progress of agriculture and agricultural engineering, and the extent to which agricultural engineers find opportunity to serve agriculture.

In order to help dealers keep up with their end of the job, the Pennsylvania Farm Equipment Dealers' Association and the agricultural engineering department of Pennsylvania State College recently developed a new 9-week training course for a limited number of dealer representatives. It is a progressive step which dealers, agricultural engineers, and colleges in other states will want to watch in the interest of developing their own opportunities for cooperation in extending service to agriculture.

Not only in the majority of the nation's passenger cars and trucks but in these great "work-horse" vehicles the Aetna Clutch Release Bearing is standard equipment. No guarantee we might write could carry more significance than that fact, no greater proof of this bearing's ability to serve faithfully and faultlessly in your mobile vehicles too.

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NEWS SECTION

ASAE Winter Meeting Program

EXPANSION of agricultural engineering technology in both old and new directions is indicated in the program for the Winter Meeting of the American Society of Agricultural Engineers, to be held at the Stevens Hotel, Chicago, December 18, 19, and 20.

The four technical divisions of the Society will each offer programs for two to three days, providing three simultaneous sessions on Monday and four on Tuesday and Wednesday. In addition there will be various committee and other small group meetings during the evenings and at other times. Brief information on the division programs, which are practically complete, is as follows:

POWER AND MACHINERY PROGRAM

The first day's power and machinery program will be sponsored jointly with the National Joint Committee on Fertilizer Application. The forenoon session (December 18) will feature reports on improvement of soil productivity by soil management and through the use of chemical fertilizers and organic materials by Frank W. Parker, U.S. Department of Agriculture, review of commercial available fertilizer distribution equipment and the kodachrome slide library by Glenn A. Cumings, also of the USDA, special equipment developed for experimental application of fertilizers by O. C. French, Cornell University, placing of fertilizer for corn by George D. Scarseth, American Farm Research Assn., and most promising methods of application of fertilizers to pastures by D. R. Dodd, Ohio State University.

Subjects to which this meeting will give attention in the afternoon are principles involved in the placement of fertilizer to truck crops by C. H. Mahoney, National Canners Assn. and J. D. Barnard, Minnesota Valley Canning Co., present status of use of liquid and gaseous fertilizers, their advantages and limitations by Proctor W. Gull, Spencer Chemical Co., aircraft application of fertilizers by M. H. McVickar, National Fertilizer Assn., the fertilizer manufacturer's problems in improving fertilizers to aid the farm implement manufacturer by Maurice H. Lockwood, International Minerals & Chemical Corp., and the fertilizer equipment manufacturer's problems in design by C. E. Guelle, International Harvester Co., W. W. Trantor, A. B. Farquhar Co., and W. A. Hyland, John Deere Van Brunt Mfg. Co.

Materials, functional parts, and complete machines for improving the economy and capacity of mechanized farming will be the subjects of reports on new research results and product development in the power and machinery sessions on December 19 and 20.

Augur types for farm machines, by E. A. Wendell, Link-Belt Co., will be the first paper on the forenoon program, December 19. Next, H. L. Geiger, International Nickel Co., will report on use of ductile cast iron in farm implements. Design and performance characteristics of the flywheel-type forage cutter head by Orrin I. Berge, University of Wisconsin, is the third item on this program.

Rapid-transfer engine units for farm machines by K. L. Magee, J. I. Case Co., is the opener for the afternoon session. New farm machines will be featured in the balance of this session, with J. G. Futral, Georgia Agricultural Experiment Station, reporting on development of a high-speed planter; Roy Bainer, University of California, presenting new concepts in side-delivery rake development, and G. W. Giles, North Carolina State College, discussing the rotating-wheel-type side-delivery rake.

Comparative performance of farm tractor tires weighted with liquid ballast and with wheel weights is to be reported by J. W. Shields, U.S. Rubber Co., and I. F. Reed, U.S. Tillage Machinery Laboratory, at the forenoon session, December 20. The remainder of the session will be devoted to corn machines, with C. W. Smith, University of Nebraska, summarizing results of efficiency studies of mechanical corn picking; and J. W. Porterfield and E. L. Barger, Iowa State College, comparing equipment and methods for cornstalk disposal.

At the closing session on December 20, J. F. Ziskal, International Harvester Co., will present an evaluation of hydraulic control systems for farm machines. The engineering development of the Case VA series Eagle-hitch tractors is to be reviewed by Geo. M. Eveleth, J. I. Case Co. A new hitch for mounted tractor plows will be described by E. V. Collins, Iowa State College, as the closing feature of the power and machinery program.

FARM STRUCTURES PROGRAM

Three major subjects will each receive special attention in as many half-day sessions of the Farm Structures Division, and a fourth half day will be devoted to miscellaneous subjects, on Tuesday and Wednesday, December 19 and 20.

The forenoon program on December 19 will feature a panel discussion on self-feeding and other forage-handling structures. Scheduled panel numbers are H. A. Arnold, University of Tennessee; A. L. Raynor, Martin Steel Products Corp.; E. G. Dueringer, A. O. Smith Corp.; and C. H. Reed, Rutgers University.

Farm product processing buildings will be the topic for the afternoon program the same day. Buildings and equipment for crop handling and storage by H. N. Curry, Iowa State College, will be the first subject. Farm product processing plants and facilities in the South by H. D. White, University of Georgia, will follow. W. M. Hurst, U.S. Department of Agriculture, will introduce the subject of feed mills and handling equipment for farm product processing. W. F. Millier, University of Minnesota, will report on experimental batch weighing and processing of the dairy ration.

Heat and moisture relationships in crop drying are scheduled for attention on the forenoon program, December 20. Presentations under this heading will be apparatus and technique for determining moisture relationships by W. V. Hukill, U.S. Department of Agriculture, results with grain sorghums by G. L. Kline, also USDA, results with rice by F. L. Aldred, USDA, and crop processing and storage problems in the tropics by Norton Ives, Inter-American Institute of Agricultural Sciences.

Individual special topics scheduled for the closing program the same afternoon include wind damage to farm buildings by M. L. Esmay and Henry Giese, Iowa State College, farm application of aluminum by J. L. McKitrick, Reynolds Farm Institute, and new approaches to crop drying problems, by E. S. Downs, Battelle Memorial Institute.

RURAL ELECTRIC PROGRAM

Electric brooding of chicks will be the subject for a panel discussion in the opening rural electric session the forenoon of December 18. D. E. Wiant, chairman, Rural Electric *(Continued on page 572)*

A.S.A.E. Meetings Calendar

November 8—IOWA-ILLINOIS SECTION, John Deere Waterloo Tractor Works, Waterloo, Iowa.

November 13—HAWAII SECTION, University of Hawaii, Honolulu.

November 18—MICHIGAN SECTION, Agricultural Engineering Bldg., Michigan State College, East Lansing.

December 18-20 — WINTER MEETING, The Stevens, Chicago, Ill.

January 26 and 27—PACIFIC COAST SECTION, Calif. Fruit Growers Exchange Bldg., 707 W. 5th St., Los Angeles, Calif.

February 5-7 — SOUTHEAST SECTION, Peabody Hotel, Memphis, Tenn.

March 23 and 24—SOUTHWEST SECTION, Texarkana, Tex.

June 18-20 — ANNUAL MEETING, Rice Hotel, Houston, Tex.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to A.S.A.E., St. Joseph, Michigan

This is the new agricultural engineering building recently dedicated on the campus of Mississippi State College. The department is headed by W. C. Howell

Essential to MECHANIZED FARMING

LINK-BELT CHAINS and SPROCKETS ON HAY BALERS

When a farm implement manufacturer uses Link-Belt Chains and Sprockets on his hay baler, he's counting on Link-Belt quality to match the engineering value of his machines, to give sturdy, durable performance under long, gruelling service. Positive chain drives are essential for proper timing on the many moving parts of automatic balers. Link-Belt manufactures a complete line of chain — one for every chain requirement. Ask a Link-Belt agricultural engineering specialist to give you the benefit of Link-Belt experience in applying chains and sprockets to your design.

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LINK-BELT
CHAINS AND SPROCKETS

NEWS SECTION *(Continued from page 570)*

Division, will open the discussion. He will be followed by Boyd Warner, Warner Brooder and Appliance Co., on conventional brooders; M. O. Whithed, Atlantic City Electric Co., on use of electric heating cable; Karl C. Seeger, Delaware Agricultural Experiment Station and J. H. Oliver, General Electric Co., on brooding with radiant energy in cold room experiments; and W. R. Kollmayr, New Jersey Power and Light Co., on the Uskon panel experimental project.

Another panel in the afternoon of December 18 will consider electric problems in barn ventilation. Scheduled contributors include C. N. Turner, New York Farm Electrification Council, reviewing the barn ventilation problem; R. J. Bugbee, on behalf of the American Machine and Metals, Inc., on developing and producing a dairy-stable ventilation system; Nolan Mitchell, Aerovent Fan and Equipment Co., on engineering perfection versus practical compromises in dairy barn ventilation; Edward Lindberg, Jr., Diehl Mfg. Co., on ventilation through air flow modulation; H. V. Walton, Pennsylvania State College, on capacity of air inlets; H. N. Stapleton, University of Massachusetts, on the application of experimental deviations; and C. W. Dexter, ILG Electric Ventilating Co., on a subject yet to be announced.

Feed grinding and handling is the subject of a panel discussion for the forenoon of December 19. D. G. Womeldorff, Public Service Co. of Northern Illinois, will introduce the subject and conclude it with a summary and recommendations. Other scheduled contributors are M. W. Forth, University of Illinois, on automatic grinding of ear corn; S. H. Foote, Jr., U.S. Department of Agriculture, on automatic feed handling with small electric power; A. S. Mowery, University of Illinois, on electric controls for automatic feed grinding and handling equipment; R. E. Johnson, Toledo Edison Co., on conveyors for transporting feed grains; R. J. Bugbee, Central Vermont Public Service Corp., on platform-type elevators; and A. D. Longhouse, West Virginia University, on conveying grain through small pipe.

A fourth panel, for the afternoon of the same day, will be devoted to stand-by generation of electric power. G. C. Neff, president, Wisconsin Power and Light Co., will open the subject with a discussion of the outage problem, and bring it to a conclusion with a summary and recommendations. H. E. Pinches, Harry Ferguson, Inc., is to present an analysis of fundamental considerations. Equipment manufacturers' viewpoints are to be represented by A. H. Hemker, General Electric Co., Mr. Koester, Fairbanks, Morse and Co., John Albers, Wincharger Corp., and H. P. Richter, D. W. Onan and Sons. Following their presentations there will be an open discussion on what farmers do or can do when the power goes off.

A symposium on farm wiring is the first feature scheduled for the forenoon program on December 20. Morris H. Lloyd, Niagara Mohawk Power Corp., is to state the problem. William Buchinger, Detroit Edison Co., will follow with observations on maypole installations for adequate wiring. L. H. Hammond, New York State Electric and Gas Corp., and N. E. MacPherson, Hydro-Electric Power Commission of Ontario, are also to contribute to this subject. Mr. Lloyd will summarize the discussion and suggest recommendations following questions and discussion from the floor.

Three contributions on corn borer control are also scheduled for this program. W. A. Pohlman, Gardner Mfg. Co., is to discuss corn borer moth protection. H. H. Beaty, Iowa State College, and J. G. Taylor, U.S. Department of Agriculture, will present separate progress reports on electrical means of corn borer control.

Economics of electricity versus bottled gas for water heating and cooking, by L. M. Mellem, General Electric Co., is the first item on the afternoon program of December 20. It is to be followed by R. S. Sheetz, Westinghouse Electric Corp., reporting on recent results of ultraviolet in animal production. Comparative performance of side-opening and immersion-type milk coolers, based on bacteria growth, will be reported by J. E. Nicholas, Pennsylvania State College, as the closing topic of the rural electric program.

SOIL AND WATER PROGRAM

The first half day of this program—forenoon of December 18—will be on drainage, sponsored by the Committee on Drainage. Virgil Marvin, Toledo Edison Power Co., will speak on operation of a farm drainage pumping plant; R. K. Frevert, Iowa State College, will report for the Committee on Depth and Spacing of Tile Drains; and Phillip W. Manson and C. O. Rost, University of Minnesota, will present evidence on farm drainage as an important conservation practice.

The afternoon program of the same day will feature related interests of drainage and irrigation. A symposium on drainage of irrigated lands will include discussion of investigations in advance of irrigation project construction by C. R. Maierhofer, Bureau of Reclamation, USDI; investigations after irrigation starts, to anticipate need for drainage, by Max C. Jensen, University of Idaho, and investigations for design of works by E. A. Olafson, F.P.R.A. (Saskatchewan). Also, Frank C. Foley, U.S. Geological Survey, will discuss ground-water resources in agricultural areas of the humid region on this program.

Conservation practices will be the general subject for the forenoon program on December 19. I. D. Wood, Soil Conservation Service, USDA, will talk on land leveling as related to drainage, irrigation, contour strip cropping and terracing. Next Lee Hermsmeier, Soil Conservation Service, and R. K. Frevert, Iowa State College, will present a joint paper on terrace construction with five types of machines. The third contribution will be on roadside erosion control work on a community basis by J. W. Harwell, Soil Conservation Service.

A varied program on the afternoon of December 19 will include consideration of some problems in treating and purifying surface water supplies for the individual farm by Harvey Wilkie, Purdue University, importance of engineering in building small dams and spillway structures for farm ponds by Marion W. Clark, University of Missouri, and flood control in the Little Sioux Watershed of Iowa by Edwin Freyberger, Soil Conservation Service.

The entire day, December 20, will be devoted to a conference on sprinkler irrigation. It will open with Aldert Molenaar reporting for his Committee on Minimum Requirements for Sprinkler Irrigation Equipment. Next, Ernest H. Kidder, Michigan State College, will lead a presentation of a summary of sprinkler irrigation research completed, in progress, and contemplated. Contributors to specific phases of this summary will be Crawford Reid, Rain Bird Sprinkler Mfg. Corp.; Milo W. Hoisveen, Columbia Basin Project; Arthur King, Oregon State College; and Frank W. Peikert, University of Maine. With this background established, the afternoon session will be given over to a discussion of needed research related to sprinkler irrigation. E. H. Kidder will preside and close the conference with a summary of important points brought out in the discussion.

Further information regarding the program and the meeting may be obtained from the ASAE headquarters office, St. Joseph, Michigan.

Earl Price Dean and Director at OSC

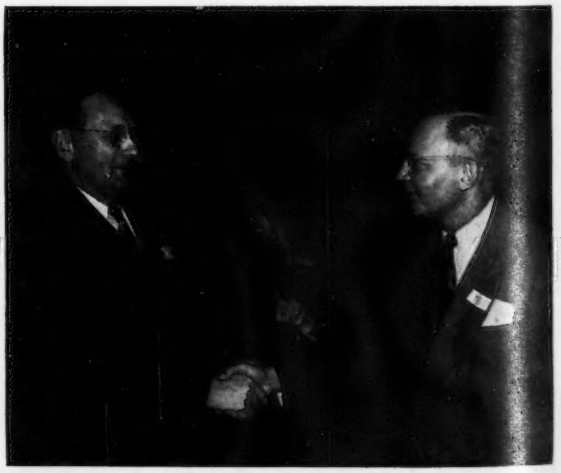
IT IS learned that F. Earl Price has recently been appointed dean of the college of agriculture and director of the agricultural experiment station of Oregon State College.

Earl Price became a member of ASAE in 1929 while serving as a member of the agricultural engineering staff at OSC. Later he was made head of the department and was for many years active in agricultural engineering research. For several years he has been serving as associate dean of agriculture and assistant director of the experiment station.

The appointment of a member of their profession to the position which Mr. Price now occupies will be specially interesting and gratifying to agricultural engineers generally.

David Weaver Is N. C. Extension Director

DAVID S. WEAVER has been appointed director of agricultural extension, North Carolina State College. In 1948 he became assistant director of the state's extension service, prior to which he served as head of the school's agricultural engineering department for about 25 years. *(Continued on page 574)*



Henry F. Carroll (left), retiring chairman, Chicago Section, American Society of Agricultural Engineers, greets the newly elected chairman of the Section, Earl D. Anderson, (right), following election of officers during the Section meeting October 9 at the research laboratory of Standard Oil Co. (Ind.), at Whiting. Mr. Carroll is manager of the farm equipment division, Montgomery Ward & Co., and Mr. Anderson is secretary of the National Sprayer and Duster Assn.

FIRST IN FARM TRACTOR HYDRAULICS • FIRST IN FARM TRACTOR HYDRAULICS

THIS IS JUST A CITY LOT!

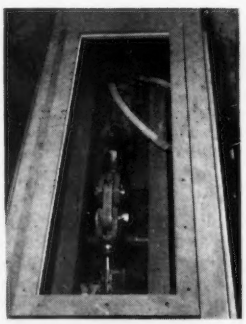
Rather than try to duplicate average field conditions for the test of their hydraulic equipment, the Experimental Engineers at Bendix-Pacific deliberately picked this sandy, rutted plot of ground as their proving ground to operate and test their equipment under the most adverse conditions.

True, this Bendix "proving ground" is just a city lot but its equipment-wearing conditions have materially contributed to longer-lived, more-dependable and less expensive hydraulic products.

In addition to the days and weeks of fighting grit and wear in the proving ground, all products get the "dust box treatment"—they are operated under simulated load conditions for thousands of cycles enveloped in swirling, highly abrasive grit in the dust box shown below.

Bendix-Pacific designs not only represent the most advanced engineering techniques but they are built from experience to do their job better and with the utmost in dependability.

It will pay you to discuss your hydraulic problems with Bendix. Many tractor and implement manufacturers have found that Bendix-Pacific can design, build and deliver to midwest and eastern markets a *better* product at a *competitive* price.



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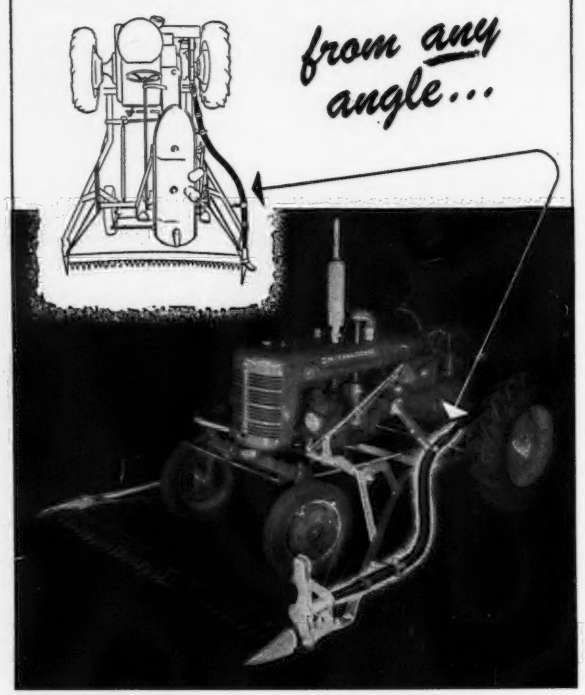
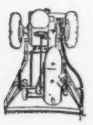


Annis Front End Mower Manufactured by Krengel's, Inc., Twin Falls, Idaho

STOW FLEXIBLE SHAFTING SOLVES POWER TRANSMISSION PROBLEMS . . . BETTER!



The problem: To provide a means of power transmission between power take-off and mower attachment that would give maximum efficiency — eliminate excessive vibration . . . eliminate danger of exposed rotating parts and costly clogging and jamming caused by dirt, grasses. Stow Flexible Shafting *solves* these problems — transmits power smoothly, safely, economically. Put Stow to work on your problems today!

Send for your free copy . . .
Stow Flexible Shafting Bulletin and Torque Calculator.

STOW MANUFACTURING CO.
39 SHEAR ST. BINGHAMTON, N. Y.

Mr. Weaver has been for many years a leader in North Carolina's rural electrification program. In 1933 he organized the North Carolina Rural Electrification Survey, which was the forebear of the 1935 North Carolina Rural Electrification Act. He served as secretary of the state's Rural Electrification Authority from 1936 to 1940, and became chairman of the Authority in 1940.

Hawaii Section Has First Anniversary

AT THE first annual meeting of the Hawaii Section of the American Society of Agricultural Engineers held in Honolulu, October 18, Rene Guillou, head, agricultural engineering department, University of Hawaii, was elected the new chairman of the Section succeeding Richard A. Duncan. Harold B. Chapson, president, Chapson & Stickler, Ltd., was elected the new vice-chairman of the Section, and Roy T. Tribble, agricultural engineer, Hawaii Agricultural Experiment Station, was re-elected secretary-treasurer. A feature of the evening was a talk on pressing agricultural problems in the trust territories by Harold A. Wadsworth, dean of the college of agriculture, University of Hawaii.

The November meeting of the Hawaii Section will be held on the University of Hawaii campus on Monday, November 13, at 7:30 p.m. G. Y. Ewart will present a paper on soil moisture studies, based on work performed on the properties of the Kekaha Sugar Company on the island of Kauai. Inasmuch as it is expected that this meeting will be outstanding, all members are being urged to attend, and a special invitation is extended to any mainlanders who may be traveling in the Islands.

Farm Hydraulic Requirements Reviewed in Conference

OPPORTUNITIES and requirements for increasing use of hydraulic power and controls on farm equipment were reviewed for the hydraulic equipment industry, on October 19, by a battery of agricultural engineers.

The occasion was the agricultural hydraulics session of the sixth annual National Conference on Industrial Hydraulics held in Chicago.

The chairman, Wayne H. Worthington, (Member ASAE), John Deere Waterloo Tractor Works, opened the session with brief remarks as to the nature of farm equipment engineering and the fact that the engineering of farm equipment now requires attention to hydraulics along with other considerations.

Jos. F. Ziskal, (Member ASAE), International Harvester Company, in picturing the application of hydraulics to the wheel-type farm tractor, reviewed the early history, requirements, and trend of development. He indicated that further progress is to be expected in refinement of control and in the variety of its agricultural applications.

Frank P. Hanson, (Fellow ASAE), Caterpillar Tractor Co., covering the use of hydraulic equipment on track-type farm tractors, showed pictures of a wide variety of applications. He followed these with a summary of the ways in which hydraulic power is used, and the possibilities of each in farm application. He mentioned particularly that the hydraulic motor might be worth further consideration, in view of the growing complexity of mechanical-drive requirements.

Following these formal presentations, Chairman Worthington called on Mr. Ziskal and Mr. Hanson, supported by J. F. Hally, and J. I. Hamilton to serve as a panel to answer questions from the floor and further develop the subject.

He also called on A. W. Clyde, (Fellow ASAE), Pennsylvania State College, to report his observations on the demand for and development of hydraulic equipment on farm machines.

It was reported during this discussion that progress is being made in the development of hydraulic equipment standards for farm tractors of more than 35 dhp.

Short Course for Farm Equipment Dealers

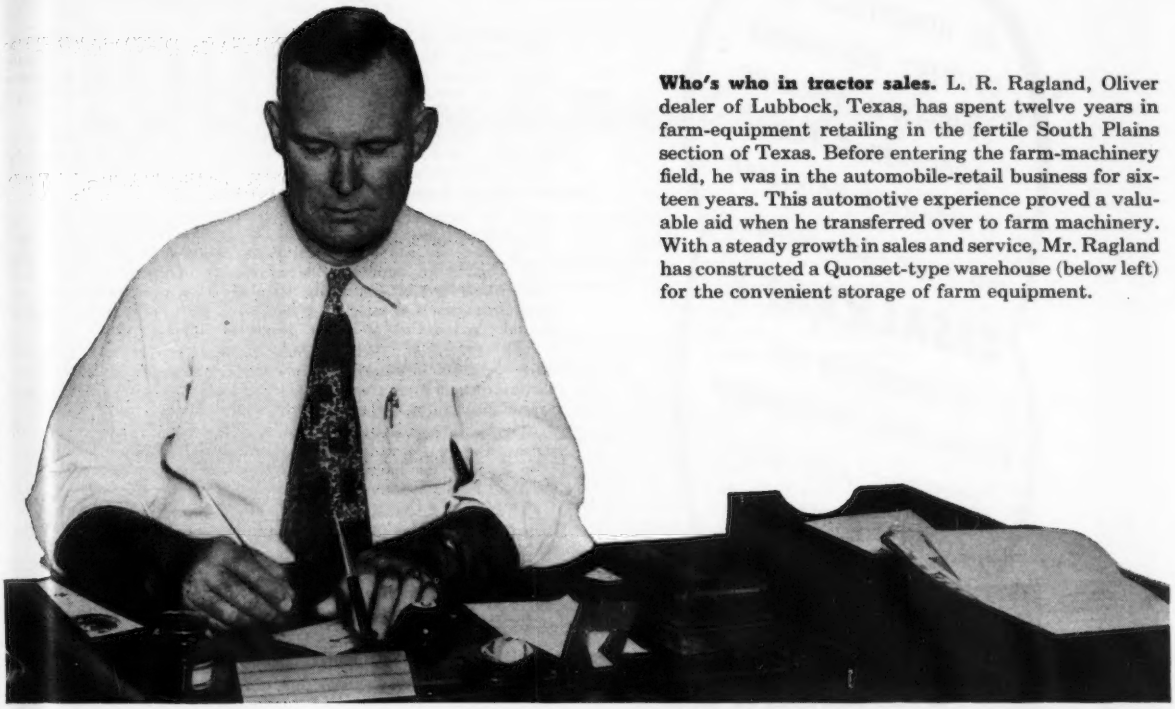
AT the request of the Pennsylvania Farm Equipment Dealers Assn., Pennsylvania State College has planned and scheduled a new 9-week training course for farm equipment dealers.

Planned as a help to young men entering the farm equipment field as mechanics, salesmen, parts men, bookkeepers, etc., the curriculum leans strongly to farm mechanics subjects. The list of subjects is as follows: agricultural economics, agricultural mathematics and physics; bookkeeping, including repair parts records and financing, dairy stable ventilation, effective speaking and writing, erosion control practices, farm water systems, hay drying, irrigation, plumbing for rural areas, refrigeration for the farm, rural electrification, tractors and machinery, and welding. A fee of $32.25 is being charged for the course and board and room cost for the period is estimated at $180.

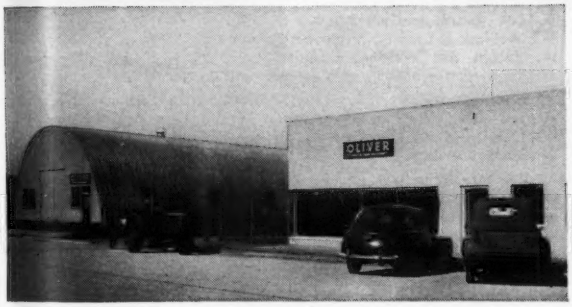
R. U. Blasingame, head of the agricultural engineering department, represented the College in working out details of the course with the Association. Much of the instruction will be handled by the agricultural engineering department staff.

(News continued on page 576)

Published by the **Ethyl Corporation** to help promote the most efficient type of farm power.



Who's who in tractor sales. L. R. Ragland, Oliver dealer of Lubbock, Texas, has spent twelve years in farm-equipment retailing in the fertile South Plains section of Texas. Before entering the farm-machinery field, he was in the automobile-retail business for sixteen years. This automotive experience proved a valuable aid when he transferred over to farm machinery. With a steady growth in sales and service, Mr. Ragland has constructed a Quonset-type warehouse (below left) for the convenient storage of farm equipment.



"High compression tractors are my best salesmen,"

says ***L. R. RAGLAND,***
Oliver dealer of Lubbock, Texas

"When a customer comes in to look at one of the new tractors, I don't try to 'sell' him. I just give him the facts about my high compression models and let him decide for himself. Take my word for it—a high compression tractor practically sells itself.

"Farmers know that our new high compression Oliver tractors deliver extra power, perform better in the field. They also know that these models give faster starting, smoother idling and cleaner burning of fuel. These extra features of high compression are the best salesmen I have."

Throughout the nation farmers are asking their tractor dealers for models that take full advantage of gasoline. Today, more than 90% of the tractors sold in this country are high compression models.

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COUNTRY GENTLEMAN
SUCCESSFUL FARMING
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SISALKRAFT
IS WORTHY OF
YOUR ENDORSEMENT
FOR THIS AND MANY
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BEFORE WINTER, IT PAYS TO
Close-in YOUR BUILDINGS
with SISALKRAFT

It pays to use SISALKRAFT for closing-in all types of farm buildings and shelters for winter. SISALKRAFT is waterproof, airtight, tough! It stops moisture, wind, rain, and dirt . . . keeps barns warmer, more comfortable and healthful for animals and fowl . . . makes the farm home cozier, more livable. Protect your machinery, too, with SISALKRAFT covers . . . in fact, there are so many valuable uses for SISALKRAFT on the farm, all year 'round, that it pays to keep several rolls on hand, always.

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205 W. Wacker Drive, Chicago 6, Ill.
Please send free sample and facts about SISALKRAFT on the farm.
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Ask your Lumber Dealer to tell you about ALL the uses of SISALKRAFT
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Farm Safety Progress

MEMBERS of the ASAE Committee on Farm Safety were notably among those present and sharing an active part in the farm safety sessions of the National Safety Congress in Chicago, October 16 to 20. Several additional ASAE members seen present for at least some of the sessions.

Theo Brown, Deere & Co., presided at the afternoon session on October 17 and at the NSC Farm Section dinner following, at which he retired as chairman of the Section. He was extended a vote of appreciation for his leadership during the past year.

E. A. Tanquary, International Harvester Co., addressed the Tuesday afternoon session on engineering for safety. He reported on some of the successes and on difficulties encountered by the farm equipment industry in improving safety features in connection with such items as power-take-off shields, tail lights for equipment trailed behind farm tractors at night on public roads, corn picker rolls, hydraulic controls, and hitches to reduce danger of tipping.

Geo. Amundson, Michigan State College, reported on rural fire safety progress in Michigan, with specific emphasis on organization for farm fire fighting and the particular applicability of low-gallonage, high pressure fog fire fighting equipment to farm fires.

Tractor-pulling contests, as conducted at county fairs in several states, came in for considerable discussion as a questionable practice from a safety standpoint, but no agreement was reached on uniform action to meet the situation.

Two farm safety session speakers who were not engineers mentioned definite plans for the early employment of safety engineers for farm safety promotion in their respective organizations.

Norval J. Wardle reported strong farm interest and effective results in county-wide farm safety clinics in Iowa.

A definite lowering of the accident, injury, and loss rate for certain types of farm accidents in some states, quite directly traceable to farm safety programs, was noted by several speakers.

Farm Welding Awards

NEW awards totaling $20,000 for the best descriptions of how arc welding is used on farms were announced October 2 by the James F. Lincoln Arc Welding Foundation. They included 141 separate awards of $50 to $1755 each to men and women in 43 states.

Albert S. Mowery, (Associate, ASAE), assistant professor of agricultural engineering at Pennsylvania State College, was joint winner with David McClay of the $1755 first award in Division II, for agricultural leaders.

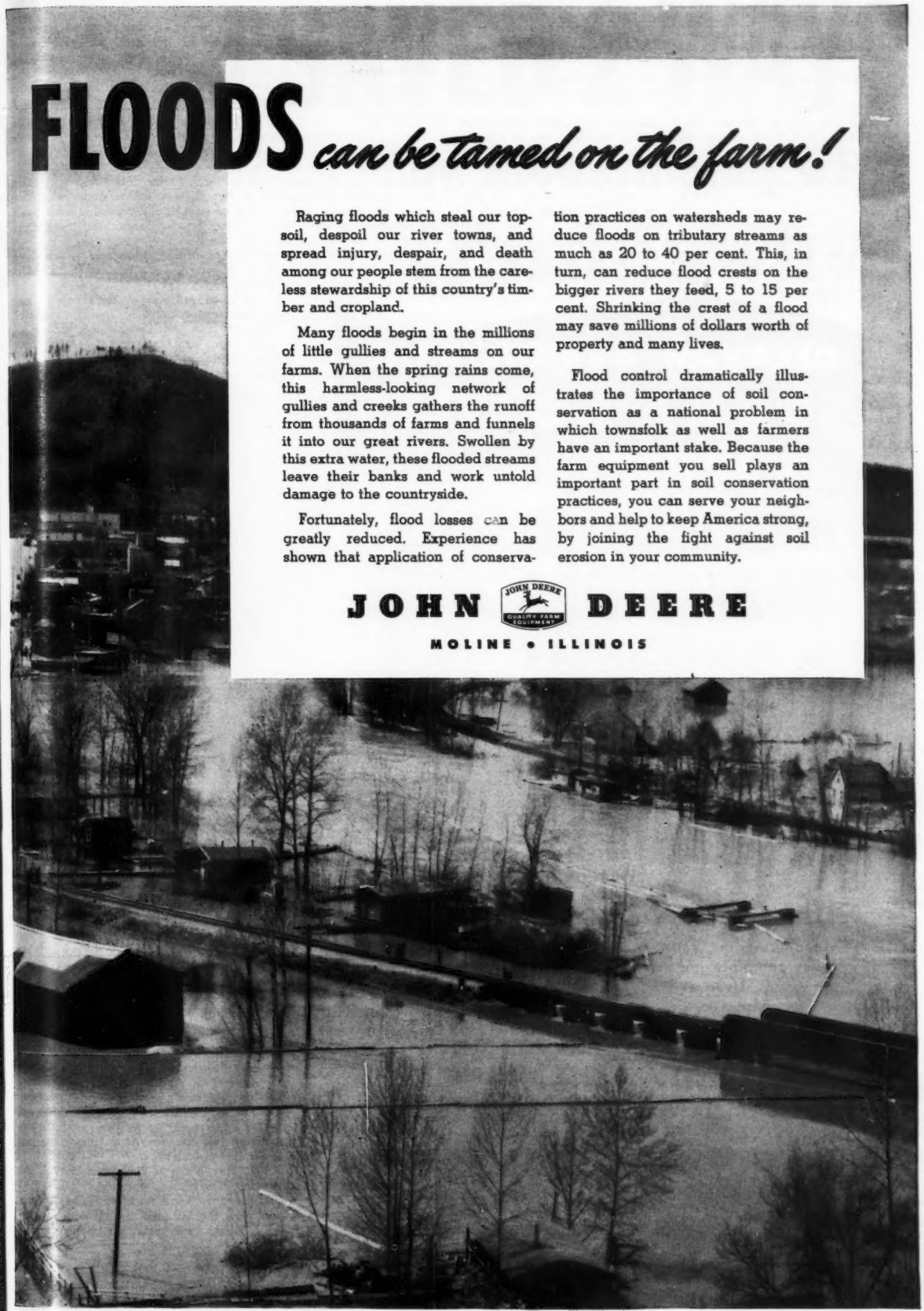
The jury of awards for the Foundation was headed by Dr. E. E. Dreese, Ohio State University. Other members of the jury, all agricultural engineers and members of the American Society of Agricultural Engineers, were E. W. Schroeder, V. J. Morford, J. W. Martin, A. H. Hollenberg, Kyle Engler, H. H. DeLong, C. F. Albrecht, O. C. French, and F. C. Fenton.

This was the second program sponsored by the Foundation to stimulate study of ways in which the industrial process of arc welding can contribute to the advance of the science and practice of farming.

In announcing the awards Dr. Dreese said, in part, "An index of the descriptions of farm-made projects entered in this program reads like a farm machine and tool catalogue. The wide variety of projects submitted in the competition not only indicates the extent to which modern farming has become mechanized, but also proves that the American farmer's ingenuity is equal to any task he sets for himself. It is this ingenuity that keeps agriculture in pace with industry in the constant effort to become more efficient, and arc welding is the means by which many farmers are able to exercise that ingenuity."

Necrology

MARY E. KEOWN, state home demonstration agent, Florida Agricultural Extension Service, passed away August 11, according to information received recently. A native of Florida, she received her bachelor and master of science degrees in home economics at John B. Stetson University, DeLand, Fla., in 1914 and 1915 respectively, and studied further in this field at the University of Wisconsin the following year. During much of her career she was in the cooperative extension work of the U. S. Department of Agriculture and the states, in various capacities. For some years she served as assistant executive secretary of the American Washing Machine Manufacturers' Assn., in charge of its educational activities. Through her interest in farm houses and home equipment she became an Associate of the Society in 1924.



FLOODS *can be tamed on the farm!*

Raging floods which steal our topsoil, despoil our river towns, and spread injury, despair, and death among our people stem from the careless stewardship of this country's timber and cropland.

Many floods begin in the millions of little gullies and streams on our farms. When the spring rains come, this harmless-looking network of gullies and creeks gathers the runoff from thousands of farms and funnels it into our great rivers. Swollen by this extra water, these flooded streams leave their banks and work untold damage to the countryside.

Fortunately, flood losses can be greatly reduced. Experience has shown that application of conservation practices on watersheds may reduce floods on tributary streams as much as 20 to 40 per cent. This, in turn, can reduce flood crests on the bigger rivers they feed, 5 to 15 per cent. Shrinking the crest of a flood may save millions of dollars worth of property and many lives.

Flood control dramatically illustrates the importance of soil conservation as a national problem in which townsfolk as well as farmers have an important stake. Because the farm equipment you sell plays an important part in soil conservation practices, you can serve your neighbors and help to keep America strong, by joining the fight against soil erosion in your community.

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NEW BOOKS

MOISTURE REQUIREMENTS IN AGRICULTURE, by Harry B. Roe, Cloth, xvii + 413 pages, 6 x 9 inches. Illustrated and indexed. McGraw-Hill Book Co. (New York 18, N.Y.) $5.50.

This first edition, subtitled "Farm Irrigation", is a new addition to the McGraw-Hill Series in Agricultural Engineering edited by Quincy C. Ayres. It is written as a text for use in colleges training engineers and other technical workers in agriculture and as a reference for irrigation farmers, agricultural technicians, and engineers. It omits as a civil engineering matter, consideration of major water supply and distribution structures, and concentrates on the distribution and use of water within farming areas and on individual farms. It further correlates irrigation engineering with soil science and gives special attention to the water requirements of different crops.

Chapters cover general considerations, sources and disposition of soil moisture, flow and measurement of water, interrelations of irrigation and drainage, fundamental principles of irrigation and problems of agriculture under it, time of irrigation, use of water in irrigation, irrigation methods, irrigation structures and works for the farm, pumping in irrigation, irrigation of specified crops, irrigation farming, legislative and administrative features of irrigaton, and supplemental irrigation in humid regions.

SOIL FERTILITY AND SEWAGE, by J. P. J. Van Vuren. Cloth, 236 pages, 6 by 9 inches. Indexed and illustrated, Dover Publications, Inc., New York, N. Y. (Printed in Great Britain) $4.50.

An account of pioneer work in South Africa in the disposal of town wastes in which experiments by the author to utilize urban waste have opened the way for establishment of municipal composting with resulting reduction in waste-handling cost, improved sanitation, and the production of valuable fertilizers for the soil.

HUNGER SIGNS IN CROPS. Revised edition. Illustrated and indexed, 370 pages. National Fertilizer Association (616 Investment Bldg., Washington 5, D.C.).

A third printing of this book to meet continuing demand was recently announced. Chapters cover background information, tobacco, corn and small grains, potatoes, cotton, vegetables, deciduous fruits, legumes, and citrus crops.

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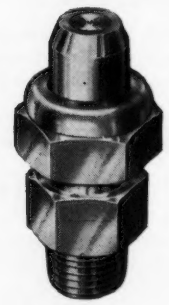

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New Bulletins

Farm Water Supply, by H. W. Kitching and T. R. C. Rokeby. Ontario Department of Agriculture (Toronto) Bulletin 476 (June, 1950). Covers water sources, supply systems, heaters, treatment, plumbing, and water supply for stock and outbuildings.

Pen-Type Dairy Barns, by L. H. Brown, B. F. Cargill, and B. R. Bookhout. Special Bulletin 363, agricultural economics and agricultural engineering departments, Michigan State College, Agricultural Experiment Station (East Lansing, June, 1950). This bulletin represents a study of both the pen-type and stanchion-type dairy housing, with the recognition that there are advantages and disadvantages in both systems. These, along with comparisons of the relative cost and labor requirements, are pointed out and recommendations are given for the successful operation of a pen-type barn. Five general rules are set forth for planning a successful pen-type barn based on the functions of good dairy-cattle housing. A portion of the 32-page bulletin is devoted to describing four types of milking parlors, one with a level floor and three with elevated stalls.

Peanut Harvesting and Drying Research, Bulletin No. 439, June 1950: A progress report of the Virginia Agricultural Experiment Station for the years 1947-48-49, 19 pages, 8½ by 11 inches. This bulletin summarizes three years of harvesting and curing investigations with emphasis on research to determine a satisfactory method for drying peanuts. The studies include drying nuts and hay together in a modified hay drier, drying nuts in a continuous-type drier in which patents are pending, and the development of quality determinations for the finished product.

Farm Trailers, Wagons, and Racks, by Wm. Kalbefleisch, J. M. Armstrong, D. J. Cooper, and A. I. Magee, Publication 830, Farmers Bulletin 159 (March 1950) Canada Department of Agriculture (Ottawa). This 24-page bulletin gives engineering recommendations on selection, construction, and use of equipment for hauling produce, recognizing this function as an important part of farming operations.

Holding Water in Farm Ponds, by H. N. Holtan. Technical Publication SCS-TP-93 (July, 1950). Based on research in cooperation with the Virginia Agricultural Experiment Station, the recommendations in this 10-page bulletin apply particularly to the limestone areas of the East, but the principles outlined may also be useful in farm pond building with similar soils elsewhere.

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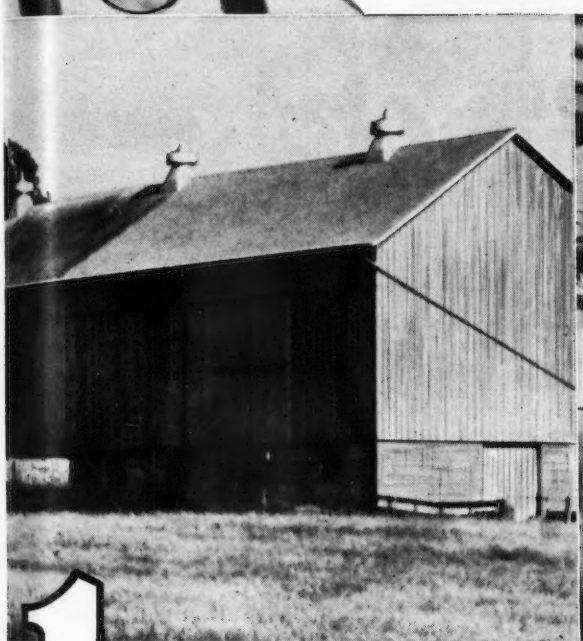

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Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Agrasar, Ramon J. E.—Chief, technical dept., agr. section, La Comercial Tecnica. (Mail) San Juan 1495, Buenos Aires, Argentina

Baskett, R. G.—Agr. attache, British Embassy, Washington 8, D. C.

Bali, J. S.—Reclamation asst., soil conservation dept., Damodar Valley Corp., Hazaribagh, Bihar, India

Blaauw, Andrew—Proj. engr., John Bean Div., Food Machinery Corp., Lansing 4, Mich.

Bopf, Edward C.—Head, product eng. dept., John Deere Des Moines Works, Des Moines, Iowa

Bowman, George M.—Sales engr., Tart-Ide Corp. (Mail) RR 2, Osakis, Minn.

Brazelton, Robert W.—Jr. engr., Blackwelder Mfg. Co., Rio Vista, Calif. (Mail) Box 674

Catacouzinos, D. S.—Dir., central laboratory, Ministry of Agriculture, Athens, Greece. (Mail) Central Soil Laboratory

Cole, Albert H.—Post-graduate student, soils dept., School of Agriculture, Cambridge, England

Crain, Wilbur F.—Res. asst. in agr. eng. and agronomy, Purdue University, Lafayette, Ind. (Mail) Agricultural Engineering Bldg.

Dixon, David W.—Des. engr., John Deere Welland Works, Welland, Ontario, Canada. (Mail) 33 Division St.

Evans, Robert C.—Student, Ohio State University, Columbus, Ohio. (Mail) 1483 Michigan Ave.

Flanigan, George B.—Mgr. of trade relations, Chain Belt Co., 1600 W. Bruce St., Milwaukee 4, Wis.

Flowers, Jesse P.—Service mgr., Darlington Tractor & Equipment Co., Darlington, S. C. (Mail) Box 475

Foote, Lorenzo S.—Res. work, div. of farm elecn. (BPISAE), USDA. (Mail) 300 Agricultural Engineering Bldg., Urbana, Ill.

Fordyce, Denny, Jr.—Agr. engr., Pittsburgh Forgings Co. (Mail) 725 Woodward Ave., McKees Rocks, Pa.

Franklin, Julian R.—Agr. engr., Office of Indian Affairs, Jicarilla Indian Agency, USDI. (Mail) Box 58, Dulce, N. M.

Gee, Herbert H.—South Hill, Va.

Geisinger, Archie C.—Farmer, Storm Lake, Iowa

Gifford, Falcnor L.—Aircraft modification mechanic, Boeing Aircraft Co., Wichita, Kans. (Mail) 3020 Schrader Dr.

Gillet, Robert B.—District sales mgr., Massey-Harris Co. (Mail) 621 2nd Ave., Albany, Ga.

Guziak, Norman J.—Sales trainee, Standard Oil Co. (Ind.) (Mail) Star Route, St. Charles, Mich.

Guzman, Jose M. G.—Chief, agr. foment dept., Consejo Nacional de Produccion. (Mail) Mariano Monge Ave., Desamparados City, Costa Rica, C. A.

Harms, H. L.—Engr. and mgr., Farmers Union Central Exchange, Box G, St. Paul, Minn.

Hartwig, Donald R.—Product des. engr., John Deere Planter Works. (Mail) 4507 18th Ave., Rock Island, Ill.

Holst, Glenn E.—District supervisor, farm machinery div., Pacific Supply Co-op, Box 4061, Portland, Ore.

Hurme, Herbert J.—Farmer, RR Box 106, Rockland, Me.

Johnston, Robert W.—Instr. in agr. engr. and asst. in exp. sta., University of Arizona. (Mail) 1105 Cedar St., Calistoga, Calif.

Jones, Walter P.—Field man, American Zinc Institute. (Mail) 347 E. Stuart Ave., Decatur, Ill.

Kent, Warren A.—Agr. engr., Illinois Power Co., Decatur, Ill. (Mail) Arbor Dell Trailer Park, RR1

Lawder, John H.—Plant and field engr., Agriform Co., Inc. (Mail) PO Box 27, Holtville, Calif.

Lovely, Walter G.—Jr. agr. engr., (BPISAE), USDA. (Mail) Agricultural Engineering Bldg., Iowa State College, Ames, Iowa

Maher, Thomas F.—Instr. in agr. eng., A. & M. College of Texas, College Station, Tex.

McLellan, Daniel J.—Co. agent at large and ext. irrigationist, North Dakota Agricultural College. (Mail) P.O. Box 507, Mandan, N. D.

Middlesworth, Vance W.—Agr. engr., Hawaiian Pineapple Co., Wahiawa, Oahu, T.H.

Miller, Dale G.—Eng. trainee, Layne-Northern Co., Inc. (Mail) RR 1, Frankfort, Ind.

Miller, Lytle G.—Agr. engr. (SCS), USDA. (Mail) 1635 W. Osage, Manhattan, Kans.

Mills, Zimri E.—Agr. engr. (SCS), USDA. (Mail) 1917 Maple St., Caldwell, Idaho

Molitoris, Michael—Thayer, Ill.

Moulton, Frank S.—Asst. prof. of agr. engr., University of Wisconsin, Madison 6, Wis.

(Continued on page 582)

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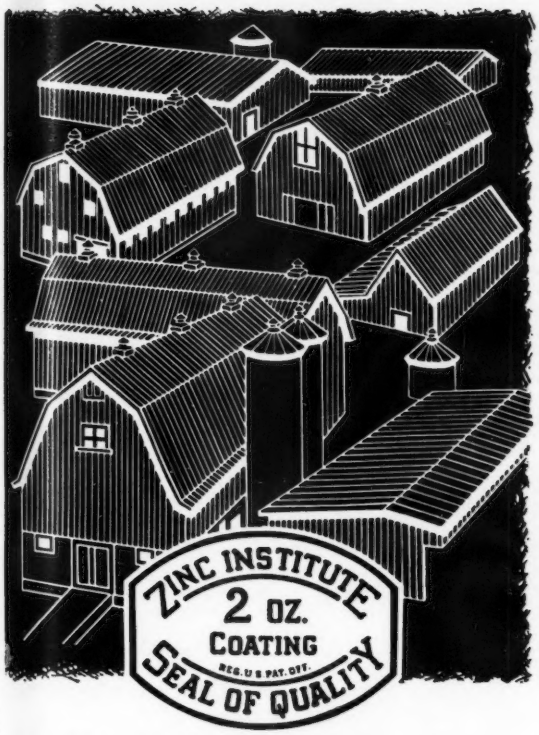

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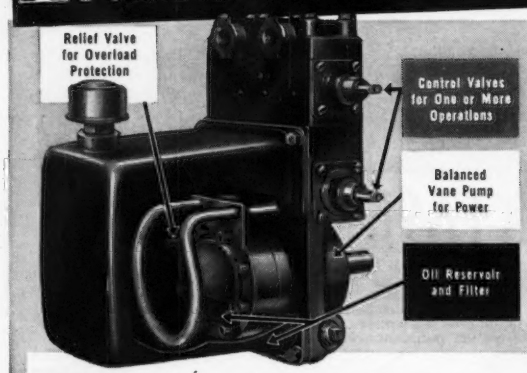
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APPLICANTS FOR MEMBERSHIP

(Continued from page 580)

Nighswonger, Lester L.—Eng. trainee, John Deere Harvester Works. (Mail) 1619 12th Ave., Moline, Ill.

Noller, Fred W.—Field test asst., Harry Ferguson, Inc. (Mail) 940 Rosevere, Dearborn, Mich.

Nuernberger, Howard H.—Head, ind. machinery section, dev. div., Aluminum Co. of America, New Kensington, Pa.

Orem, Max T.—Agr. engr., Purdue University, West Lafayette, Ind. (Mail) 209 W. North St.

Overing, John E.—RR 4, York, Nebr.

Paterson, A. V.—Managing dir., Dunell Ebden & Co. Pty., Ltd. (Mail) P.O. Box 1106, Port Elizabeth, South Africa

Rich, Richard I.—Trainee, Eastern States Farmers' Exchange. (Mail) 79 Pleasant St., Dover-Foxcroft, Me.

Richardson, James A.—Farm rep. trainee, Gulf States Utilities Co., Baton Rouge, La. (Mail) 150 Leaway

Riddle, Frederick W.—Chief engr., Pittsburgh Forgings Co. (Mail) Mt. Nebo Rd., RR 2, Sewickley, Pa.

Rooney, Robert P.—Dist. ext. agr. engr., Cornell University. (Mail) Box 315, Chestertown, N. Y.

Sahs, John A.—Graduate student, University of Nebraska, Lincoln, Nebr. (Mail) 3010 Ryon St.

Sanner, Kelly A.—Engr., Midwest Building Co. (Mail) Box 183, Bethany, Ill.

Shelton, E. E., Jr.—District rural sales engr., Alabama Power Co., Gadsden, Ala.

Sherwood, Earl M.—Graduate asst. in agr. eng., Michigan State College, East Lansing, Mich.

Stanley, H. B.—Plantation engr., Hawaiian Pineapple Co. (Mail) 216 Koa St., Wahiawa, T. H.

Swenson, George W. P.—Engr., Empresa de Servicios Agricolas Mecanizados, S. A. Casilla 3984, Guayaquil, Ecuador

Tait, Robert S.—Mgr., Rain Bird Sprinkler Mfg. Co. (Canada), Ltd., c/o Traders, 343 Railway St., Vancouver, B. C.

Traywick, Jack D.—Instr. in agr. eng., University of Tennessee, Knoxville, Tenn.

Tuller, Margaret H.—Housing spec., Oregon State College, Corvallis, Ore.

Wagner, William V.—Field engr., Portland Cement Assn. (Mail) 1387 Lowther St., Highland Park, Camp Hill, Pa.

Welch, Calvin E.—Asst. mgr., Monarch Lumber Co., Fairfield, Mont.

Zoerb, Gerald C.—Instr. and res. asst. in agr. eng., South Dakota State College, Brookings, S. D.

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Brandt, Roy G.—Des. engr., The Oliver Corp., South Bend, Ind. (Mail) 229 LaPorte Ave. (Junior Member to Member)

Geiger, Harold L.—Sr. product engr., Dearborn Motors Corp. (Mail) 18977 Evergreen Rd., Detroit 19, Mich. (Junior Member to Member)

Roth, Robert R.—Des. engr., Minneapolis-Moline Co., Moline, Ill. (Junior Member to Member)

New Bulletins

Protection of Building and Farm Property from Lightning, by Roy N. Covert, Louis P. Harrison and Harry L. Garver. Farmers Bulletin No. 1512, U.S. Department of Agriculture (Revised June, 1950). Up-to-date information for farmers on lightning protection for buildings, silos, flag poles, trees, livestock, and persons.

EROSION
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Fence rows and farm boundaries mean nothing to the destructive work of erosion. We must put the tools of conservation to work if we are to save our soil and protect its fertility.

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Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. The Society does not investigate or guarantee the representations made by parties listed. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request. "Agricultural Engineer" as used in these listings, is not intended to imply any specific level of proficiency, or registration, or license as a professional engineer.

NOTE: In this Bulletin the following listings still current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated:

POSITIONS OPEN: JUNE—O-355-717, 393-719. JULY—O-360-722, 421-726. AUGUST—O-25-503, 25-504. SEPTEMBER—O-34-506. OCTOBER—O-75-507, 76-508, 46-509.

POSITIONS WANTED: APRIL—W-291-373, 307-375. MAY—W-339-384, 349-385. JUNE—W-364-393, 387-399, 274-400, 354-403. JULY—W-382-408, 337-409, 398-411, 412-413, 417-415. AUGUST—W-5-1, 4-2, 11-3, 26-5. SEPTEMBER—W-39-8, 38-9, 40-10, 48-11. OCTOBER—W-66-12, 69-13, 73-14, 71-15.

NEW POSITIONS OPEN

GRADUATE ASSISTANTSHIPS, one each in soil and water and farm machinery fields in the agricultural engineering department of a land grant university in the Southeast. Teaching and graduate study one-half time each. Can complete requirements for MS deg in agricultural engineering in two years. BS deg in agricultural engineering, or equivalent, and some experience either in industry or teaching. Must have ability to work with students, cooperate with other staff members, and conduct research work. Prefer applicants with scholastic average of B or better. Permanent position in soil and water field may be open in 1953. Age, under 35. Salary $1200. O-102-510.

GRADUATE ASSISTANTSHIP in irrigation, in agricultural engineering department of a land grant college in a north central state. Half time on irrigation research; half on study toward an MS degree. BS deg in agricultural engineering, or equivalent. Usual personal qualifications for advanced study and research. Possible to earn master's degree in about four quarters. Opening effective beginning next quarter. Salary $110 mo. O-104-511.

RESEARCH FELLOW for half time work assisting in cotton mechanization research and half time work toward master's degree, in agricultural engineering department of a land grant college in a south central state. BS deg in agricultural engineering, or equivalent. Interest in farm machinery and in research. Good health. Ability to follow directions and take accurate data. Possible to earn master's degree in about one calendar year. Opening effective January 1 to February 1. Age 20-35. Salary $115 mo. O-108-512.

RESEARCH FELLOW for half time work assisting with runoff studies in soil conservation research and half-time work toward master's degree, in agricultural engineering department of a land grant college in a south central state. BS deg in agricultural engineering, or equivalent. Interest in soil conservation and research. Good health. Ability to follow directions and take accurate data. Possible to earn master's degree in about one calendar year. Opening effective January 1 to February 1. Age 20-35. Salary $115 mo. O-108-513

NEW POSITIONS WANTED

SALES and service in farm machinery or rural electric field, with manufacturer or utility serving rural area, preferably in eastern U. S. BS deg in agricultural engineering, Pennsylvania State College, August 1950. Experience as cable splicer's helper with Bell Telephone Co., 5 yr. Electrician's helper, 3 mo. Recorder on slitting machine, J & L Steel Co. War enlisted, cadet, and commissioned service in Navy, 2 yr, 9 mo. Age 29. No disability. Available on reasonable notice. Salary open. W-93-16

DEVELOPMENT, research, teaching, or writing, in farm structures or product processing field, in industry or public service, preferably in seaboard location. Willing to travel, extensive knowledge of entire U. S. BS deg in agriculture, major in agricultural engineering, expected January 1951. Tool and die maker 10 yr, including some each of supervisory, design, and master mechanics department work. Hydraulic mining, 2 yr. Married. Age 36. Subject to sinusitis and bronchitis, no bar to work. Available Feb. 1. Salary open. W-72-17

RESEARCH or design and development work on tillage, cultivating and planting machines, with experiment station in North Central area. Prefer sugar beet growing area. Trained in agricultural institute, 1925; technical institute, 1933 (Europe). MS deg. Experience on large farms, in experiment stations, and as design engineer and teacher, in farm machine field, 25 years. Married. Age 52. No disability. Available on short notice. Salary open. W-99-18

TEACHING, research, sales, or service in power and machinery or soil and water field, in industry or public service in U S A, Europe or South America. BS deg in agricultural engineering 1942, University of Georgia. Expect to complete work for MS deg in agricultural engineering by January 1, 1951, Virignia Polytechnic Institute. Farm background. Served in Marine Corps 4 years before entering college. Field reporter for AAA during summer vacations while in college. Nearly 6 years war and postwar service in Europe, commissioned and civilian, as administrative ordnance officer and civil affairs and military government officer. Teaching fellow at Virginia Polytechnic Institute in 1949 and '50. Married. Age 35. No disability. Available January 1. Salary open. W-80-19

EXTENSION, teaching, or research in farm structures or rural electrification with industry or public service, anywhere in U.S.A. Willing to travel. BS deg in agricultural engineering 1947, Mississippi State College. MS deg in agricultural engineering, 1950, Texas A & M College. Farm background. Teaching 2 years. War enlisted service in Army Air Force, 3 years. Single. Age 30. No disability. Available on two weeks' notice. Salary open. W-109-20